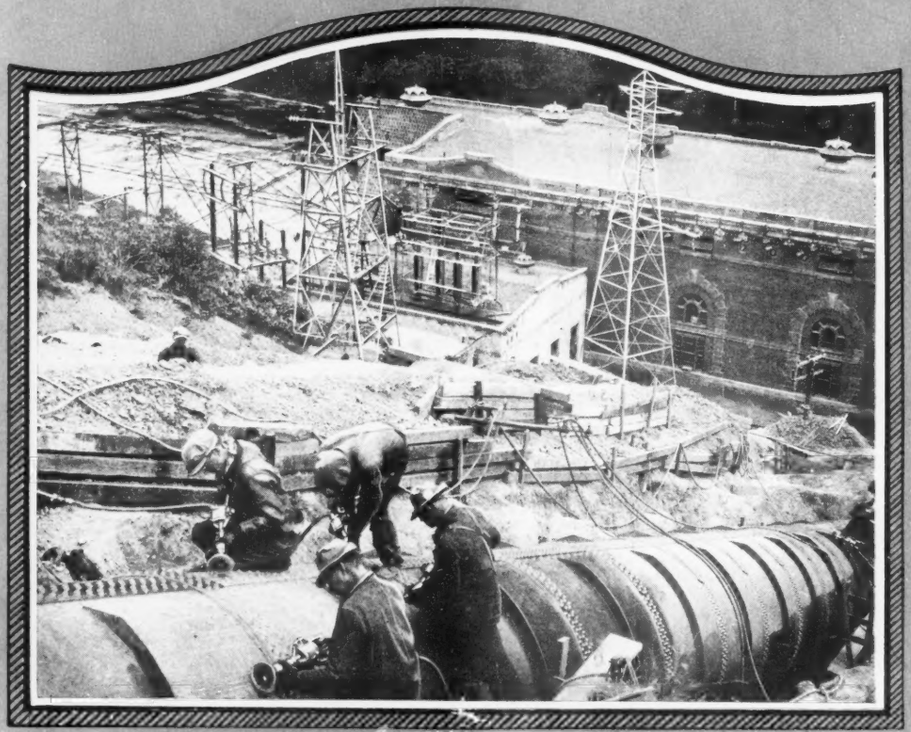
Compressed Air Magazine

Vol. XXX, No. XII London New York Paris 35 Cents a Copy

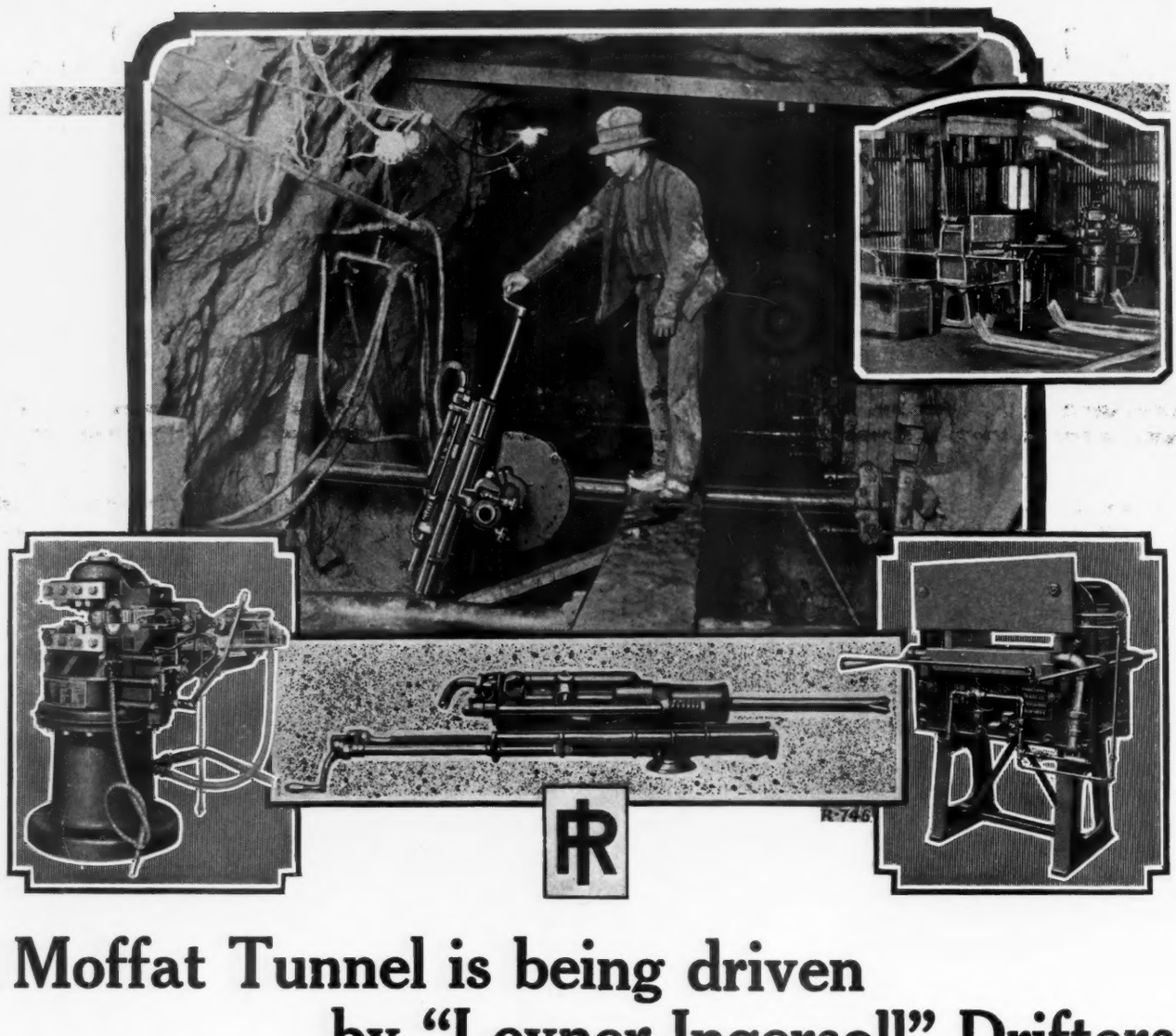
DECEMBER, 1925

CIRCULATION THIS ISSUE
25,932 COPIES



AIR-DRIVEN WIRE BRUSHES MAKE COMPARATIVELY LIGHT WORK OF CLEANING STEEL PENSTOCKS FOR REPAINTING

(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 5)



Moffat Tunnel is being driven by "Leyner-Ingersoll" Drifters

"Leyner-Ingersoll" R-72 Drifters are used at both portals of the Moffat Tunnel. The extremely severe service to which these drills were subjected established the fact that the R-72 is more powerful, is faster, and has less vibration and greater durability than any other Rock Drill tried on that work.

The R-72 Drifter is perfectly balanced. It is of simple, rugged construction with no projections. It is ideal for top holes and lifters. It has double exhaust ports, an efficient lubricating system, and unusual hole-cleaning facilities.

In addition to the R-72 Drifters, the following Ingersoll-Rand equipment is employed on the Moffat Tunnel:

Air Compressors
"Leyner" Sharpeners
"Leyner" Shank and Bit Punches
I-R Oil Furnaces
I-R Pedestal Grinders

We will gladly send you complete information concerning any of the above equipment.

INGERSOLL-RAND COMPANY-11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over

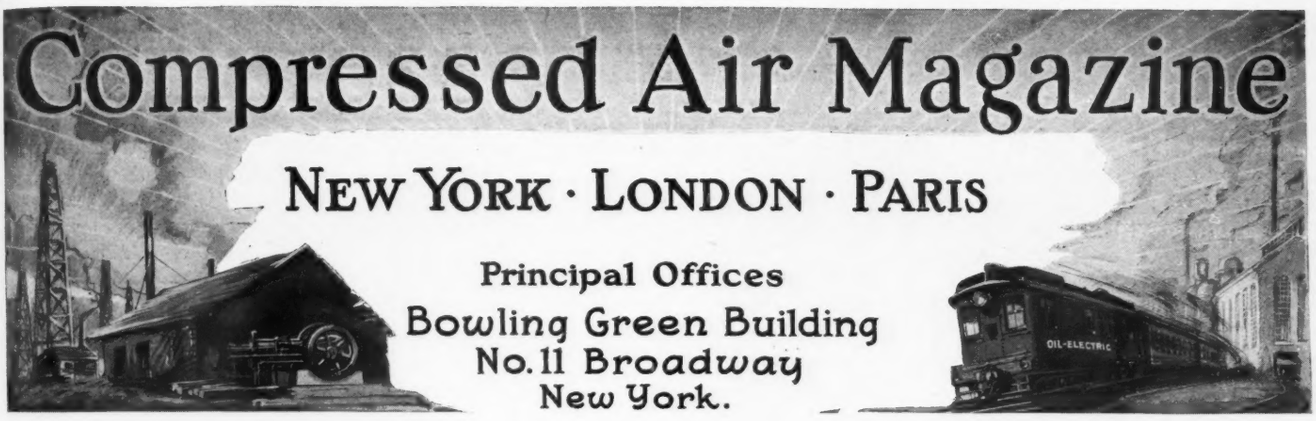
CANADIAN INGERSOLL-RAND CO LIMITED.
260 ST JAMES STREET. MONTREAL. QUEBEC.

INGERSOLL-RAND CO LIMITED.
165 QUEEN VICTORIA STREET. LONDON. E.C.4

151-LT

Ingersoll-Rand

As a matter of reciprocal business courtesy help trace results



VOL. XXX, NO. XII

DECEMBER, 1925

Valuable Industry Developed From Hunting Trip

Barton's Discovery of Garnet in the Adirondacks and His Invention of Garnet Abrasive Papers Blazed the Way for Many Industrial Uses of the Mineral

By A. S. TAYLOR

HIGH hats, French heels, and shining mirrors are logically identified in the popular mind with finishing work that calls for more or less delicate manipulation to make them what they are. But we are going to discover that Jackhamers, dynamite, and the abrasive crystals found in certain rocky strata of the Adirondack Mountains have also their parts to play in producing the foregoing raiments of fashion and in giving to plate glass its beautiful transparency.

Until within a comparatively short span back, the garnet—classed among semi-precious stones—was used well-nigh exclusively as an adornment and was marketed by jewelers. It found very little other use save as bearings in some classes of cheap watches. Garnet as an abrasive did not acquire commercial importance before 1880, when that use of the mineral was developed in this country. Before telling the story of the start of this distinctly American industry, it might be well to mention why garnet is especially desirable as an abrasive.

To quote the United States Bureau of Mines: "The term 'garnet' is applied to a closely related group of minerals which crystallize in the same forms and possess similar physical properties, although their chemical composition may exhibit greater variations." Garnet is harder than quartz, which is commonly employed in the manufacture of sandpapers. The hardness of garnet may range from 6.5 to 7.5, according to Moh's scale; and certain massive forms of garnet have a hardness of nearly 8.0 while quartz has a hardness of 7.0.

Massive garnets and well-formed crystals of the mineral are notably tough and can be shattered only with difficulty. The almandite garnet found in Warren County, New York, for example, breaks under considerable pressure along approximate lines called "parting planes;" and, when further fractured by sufficient pressure, these particles develop chisel-like edges which are capable of cutting many materials. Besides this, the garnet particles in breaking up in service give birth to other keen edges which continue the desired abrasive action. Particles of silica sand, when similarly employed, are likely to grow dull and ineffective much faster.

GARNET as an abrasive material is employed in steadily increasing quantities in various departments of industry. We lead the world in this utilization of garnet as we also do in the mining of the mineral. Such being the case it should interest our readers to learn how garnet is mined and milled by the company that works the largest known deposit of almandite garnet. The story of the Barton mines should appeal to the imagination because once more we learn how chance was mainly responsible for the founding of an activity which has latterly assumed added importance.

The foregoing characteristic of the best of almandite garnet is, so the geologists tell us, due to the fact that the garnet nodules, when crystallizing within the enveloping and solidifying rock, were acted upon by tremendous compressive forces which arrested the complete crystallizing of the nodules and set up inside them stresses which induced innumerable insipient fractures or cracks. These more or less well-defined fractures now cause the garnet granules to take on their multiple cutting edges which make the mineral so valuable when used as an abrasive. It is undoubtedly true that such is the pronounced physical peculiarity of the garnet obtained by the Barton Mines Corporation from the deposits worked by that enterprise on the slope of Gore Mountain at an elevation of 1,800 feet above the nearest community, the Village of North River, N. Y., three miles away. Also, the quality of the garnet concentrates produced there has not varied since operations were begun at that point years ago.

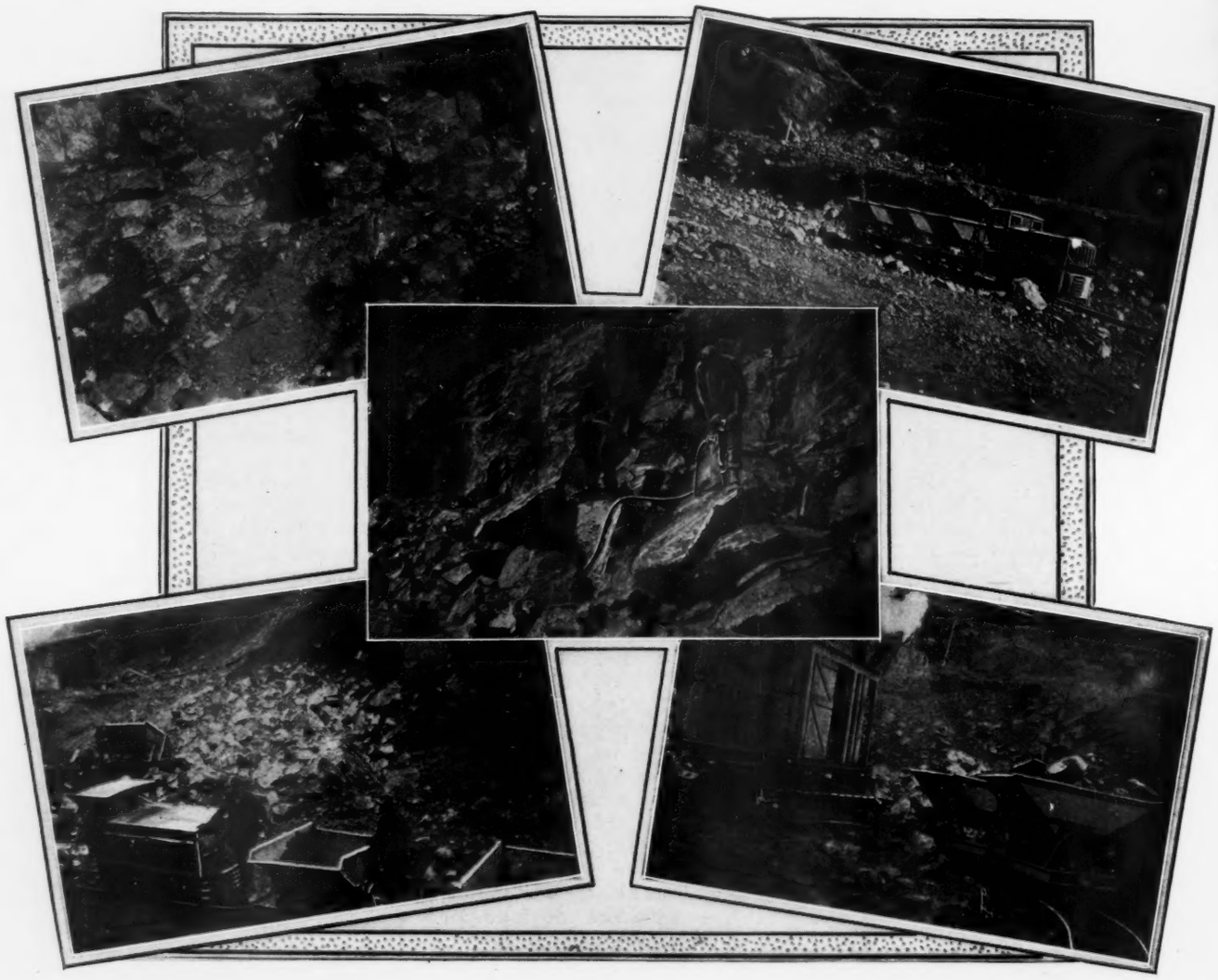
The story of the discovery of what are now known as the Barton Mines is not without human interest. Briefly, about 40-odd years ago, the neighboring mountainside was mainly valuable because of its stands of marketable timber owned at the time by a lumber dealer in Glens Falls—Zenith VanDusen by name. One day, an employee of VanDusen's local representative went to a brook that flows down the mountainside to slake his thirst, and as he knelt to drink from that clear stream he was attracted by several good-sized pieces of transparent claret-colored rock. It took him but a matter of a few minutes to pick up enough of these fragments to fill his pockets; and

when he got back to North River he gave his boss, William Moore, some of the unfamiliar mineral. Moore did not know that the samples were bits of garnet, and for a year or more afterwards he spoke of the mineral as "red rock." However, his curiosity was aroused by his subordinate's discovery; and by following up the stream he was able to locate the outcroppings from which the pieces of garnet had been detached by the weather and carried down into the brook by rain and the springtime floods from melting snows. It was not until William Moore was brought by chance in touch with H. H. Barton, of Philadelphia, that the true nature of the ledges of "red rock" was made known.

Henry H. Barton was a jeweler by training who, after some years in the jewelry business, became a manufacturer of sandpapers. Business anxieties brought him to the verge of a breakdown, and he was urged to take a vacation for his health's sake. Being an ardent sportsman, he decided to go to the Adirondacks on a hunting trip. This was back in the early "eighties." While on Gore Mountain in quest of deer and other game, Mr. Barton was shown some specimens of the garnet ore which had been broken off from the outcroppings by William Moore. A little investigation by Henry Barton revealed the extensive nature of the outcroppings and the somewhat unusual character of the formation. At first, Mr. Barton reacted to the discovery as a jeweler, but it soon dawned upon him that the gem market would not offer a sufficient outlet for the profitable disposition of the abundantly available material. Then it came to him that the garnet, because it was harder than the quartz sand commonly used in the making of sandpapers, might be used instead for that purpose. Accordingly, before returning to Philadelphia, he obtained an option upon a considerable tract of VanDusen's land.

Taking away with him a sufficient supply of garnet nodules, which could be easily detached from the enveloping and somewhat weathered rock, Mr. Barton crushed the mineral and utilized the particles in the preparation of experimental sheets of abrasive paper and then tested these in competition with his regular flint sandpapers. The outcome of those tests was very encouraging, and the superiority of the new product became so evident that it was not long before Barton garnet paper led the field. At that time, and for sometime thereafter, Barton had a monopoly because he controlled the only known workable source of the essential raw material, and the business grew apace.

For nearly forty years, the H. H. Barton & Son Company, which still owns the property on Gore Mountain, mined the garnet for its own use exclusively, and the method employed in doing this was so simple as to be nearly primitive. That is to say, the garnet rock was detached from the ledge by hand drilling and blasting; and then the large garnet nodules were broken free by hand cobbing. This work was of an intermittent or seasonal nature, the output was relatively small, and much valuable rock was thrown on the dump. In fact, a great deal of the rock was taken out under contract, and the contractors were not concerned about how the property was treated the while. They followed the line of



Typical scenes in the quarry where granite nodules are obtained ranging in size from 2 inches to 3 feet in diameter.

Left—The ore is loaded at the quarry into 3-ton Koppel side-dump cars.
Right—A steam shovel does the mucking at the quarry.

least resistance and dumped their refuse and the overburden anywhere they found convenient. That procedure has added considerably to the task of the well-ordered management which now has the property in hand. Rock from the erstwhile dumps is today being run profitably through the mill.

According to Mr. T. S. Mennie, Manager of Mines, the garnet is found in a porphyritic rock consisting largely of hornblende and feldspar enclosed in gneiss. The imperfectly developed crystals are nodules varying from 2 inches to 3 feet in diameter—each nodule being enveloped by a shell of hornblende. The specific gravity of hornblende is 3.2, while that of garnet ranges from 3.2 to 4.3. The nearness of the two minerals in this respect adds to the difficulty of effecting the separation of the garnet from the gangue. This is especially true of the separation of the fines, which represent no small part of the recovered values.

The property covers an area of 7,000 acres, on which outcroppings indicate a vein 2 miles long. The width and the depth of the vein are still undetermined although quarried for a width of 200 feet and to a total depth of 80 feet on three benches. Beginning last year, the Barton Mines Corporation took over the lease of the property and erected an up-to-date mill capable of producing 8,000 tons of marketable garnet a year. The mill was finished and put in operation in August, 1924, and is now handling 250 tons of ore daily. The mill runs continuously from 7 a. m. of a Monday until 7 a. m. of the following Sunday—the force working in three 8-hour shifts. The total personnel engaged in the mill, in the quarry, in the blacksmith shop, etc., numbers 80 men. Previously, the deposit yielded annually about 900 tons of commercial garnet which was, as has been said, utilized only by the H. H. Barton & Son Company's plant in Philadelphia. Under the new arrangement, the output is sold to anyone desiring the garnet for one purpose or another. In passing, it should be recalled that the production of abrasive garnet in the United States has nearly doubled in the last ten years. That is to say, in 1914, the output was 4,231 short tons valued at $145,500, while production in 1924 totaled 8,290 short tons valued at $674,176.

Drilling on the benches is done with "Jackhamers" which drill 10-foot vertical holes.

Top—Tractor filling up with gas for its trip to rail head, eleven miles away.
Left—A train load of ore running into the mill.
Right—A tractor and trailer can move about 15 tons of garnet concentrates at one time.

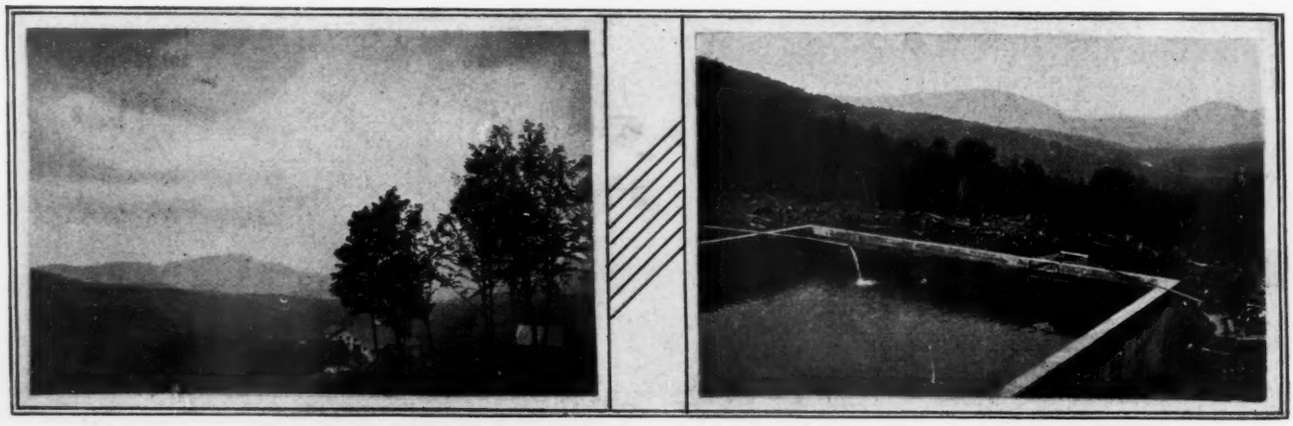
Various parts of the picturesquely located camp. The upper picture shows the mess hall and the general store, and was taken when the men were headed up hill to noonday chow.

Lifters, to clean up the bottoms of the benches, are usually drilled to a depth of from 6 to 8 feet. The shooting is done with 40 to 60 per cent. dynamite, and boulders are blockholed with small charges of the same explosive. The broken ore is then loaded by power shovels into 3-ton Koppel side-dump cars and hauled to the mill by Plymouth gasoline locomotives. In breaking the ore in the quarry many garnet crystals are shattered and released, and the largest fragments of clean garnet so freed are picked up and sacked on the spot for shipment.

Upon reaching the mill, the ore is dropped into a big receiving pocket directly in front of a 24x36-inch Traylor crusher, requiring 75 H.P. to drive it. The crusher is set to crush the rock into pieces not larger than 3½ inches. From the crusher the ore is carried by a feeder to a bucket elevator which, in its turn, delivers the material to a double trommel made up of two concentric cylindrical screens—the inner screen withholding the large pieces of ore so that the enveloping screen, which is perforated with ¾-inch holes, can handle the smaller material. The undersize from this trommel is conveyed to a storage bin of 500 tons capacity. The oversize from the trommel is moved by a picking belt equipped with a magnetic head pulley to get rid of any "tramp iron." From this belt an attendant picks out any pieces of wood; and clean or high-grade garnet is also removed by hand from this slow-moving carrier. Next, the ore is delivered by the belt to a Telsmith reduction crusher, set to crush to ¾ inch, whence the ore is returned to the bucket elevator operating in connection with the first crusher and delivered to the ¾-inch trommel just referred to. By means of this closed-circuit arrangement, the ore is dealt with repeatedly and only minus ¾-inch material is deposited in the 500-ton bin. This treatment ends the crushing side of the mill; and the ore is now ready to be fed from the storage bin to the separating department of the mill.

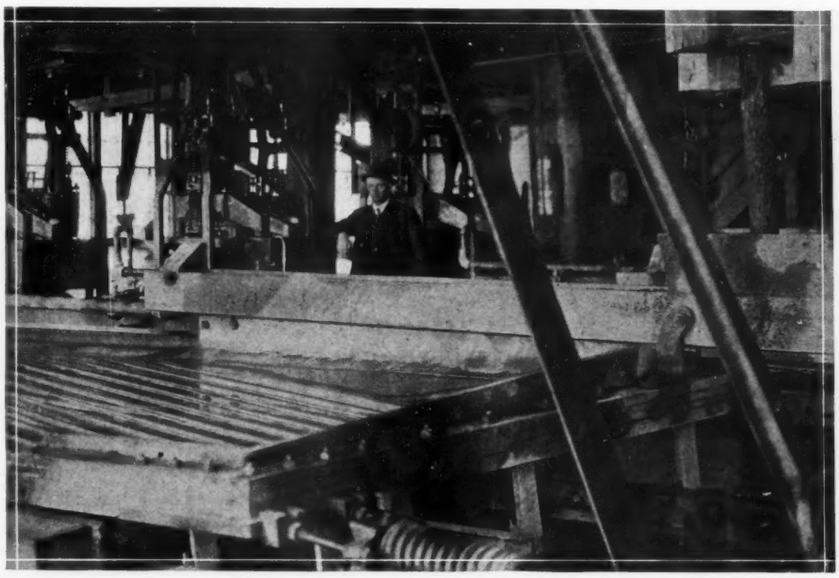
Concentration is effected through the mediums of gravity and water. The water used for this purpose is obtained by seepage from the adjacent mountain slope and impounded in an open concrete reservoir near the mill. So far, even in the driest seasons, enough water has been available; but the water is used over and over again and recovered by a Dorr thickener. The incoming clean water is first run through the water jackets of the oil engines, the air compressor, and the pitman and bearings of the big crusher, and then goes to the different sections of the concentrating department.

A conveyer takes the minus ¾-inch ore from the storage bin and delivers it to an elevator which, in its turn, feeds the ore to a group of five trommel screens. Thus the ore is separated approximately into five sizes. The holes



Left—Looking westward from the camp toward the mill in the valley below.
Right—This reinforced-concrete reservoir is kept filled by seepage from the adjacent slope of Gore Mountain. The mill draws its water from this source.

in the largest screen are ½ inch in diameter while the holes in the smallest screen are about 1/10 inch in diameter. The oversize from the ½-inch trommel is delivered to Traylor rolls set about ⅜ inch apart, and after going through these rolls the ore is returned to the feed circuit. The net result of passing the ore through the trommels is to produce four oversizes and one undersize, or fines. The four oversizes are treated on a group of eight James diaphragm jigs, each of which has three compartments. These jigs automatically separate the gangue from the garnet; and the middling is returned to the feed circuit for retreatment while the tailings or waste goes to the Dorr thickener where the water is reclaimed for re-use.



Small jigs combined with roughing and finishing tables concentrate the garnet fines.

The undersize from the 1/10-inch trommel —being fines, is subjected to a rather novel treatment by a layout consisting of four James sand roughing tables and four James sand finishing tables in combination with four small single-compartment James automatic diaphragm jigs. The tables and the jigs are disposed so as to form a closed circuit; and the arrangement is the outcome of a suggestion by Mr. U. S. James previously applied by Mr. Mennie in another mill where the problem was to produce a marketable grade of garnet from fines carrying a gangue of very nearly the same specific gravity as that of the garnet.

As explained by Mr. Mennie: "The procedure consists of putting the total feed over roughing tables and of making a tailing waste, a middling, and a rough or dirty concentrate. The concentrate is then cleaned by diaphragm jigs having a very fine screen and a bedding of bird shot. The screens operate on a 3/16-inch stroke. The jigs discharge a concentrate containing about 90 per cent. garnet as well as a tailing which is added to the roughing-table middling and passed on to the finishing tables. The finishing tables produce a tailing waste, a middling which is returned to those tables in their own feed, and a dirty concentrate which is handled by the diaphragm jigs —thus operating a closed circuit between the jigs and the finishing tables. In brief, the tables produce all the tailing waste and the jigs yield all the concentrate from the fines."

All tailings are elevated to the top floor of the mill where they are delivered for dewatering to a duplex Door classifier—the dewatered tailings being discharged from the building and dropped upon the dump. Similarly, all concentrates are raised to the same floor where they are treated by a simplex Dorr classifier which dewaters them. The water overflowing from the two classifiers is carried to a Dorr thickener which reclaims the water for further use in the mill.

The dewatered concentrates are conveyed mechanically to a Lowden oil-fired drier located in the basement of the mill. The concentrates are disposed of in the form of a bed on top of the drier where a multiple-bladed mechanical rake progressively moves the garnet from the feed to the discharge end of the drier—the whole journey taking about thirty minutes. The drier is 6 feet wide and 30 feet long, and carries when loaded approximately 10 tons of the mineral. At the discharge end, the garnet is packed in 100-pound bags. Marketable concentrates contain not less than 80 per cent. garnet, but the final product turned out by the Barton mill is made up of from 90 to 95 per cent. garnet.

The power plant of the mill is equipped with two vertical 130-H.P. oil engines which drive, by two belts, separate sections of a coupled line shaft—the coupling being interposed so that either engine may be used to drive the right or the left section of the shaft. Nor-

Top—Office at Gore Mountain camp.
Left—Main mill before recent extension was made.
Right—New mill where garnet grains will be graded for the market.

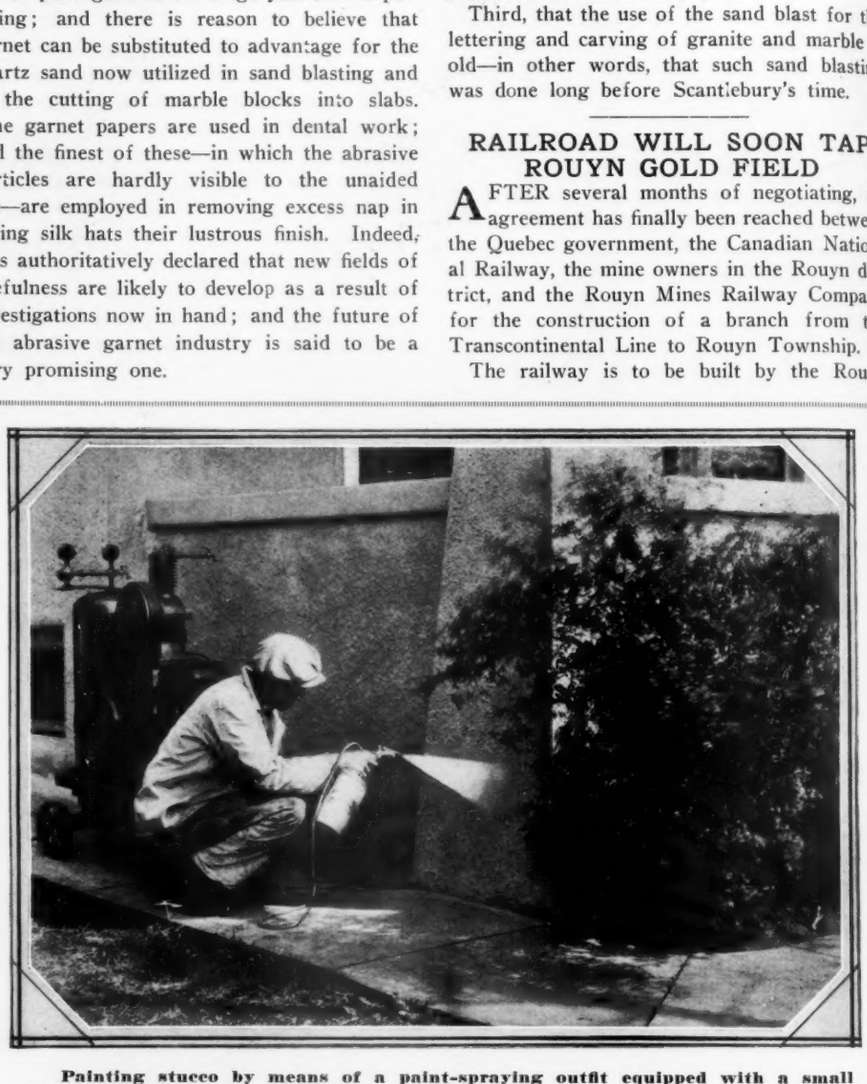
mally, one engine provides power for the crusher plant and for the operation of a belt-connected compressor, while the other engine furnishes power for the separating department of the mill and for a 60-Kw. generator. This generator supplies current for lighting throughout the camp and the mill and for driving a few small motors installed about the plant. The compressor furnishes air at a pressure of 80 pounds for the operating of "Jackhamers" in the quarry; and compressed air is also used for cleaning electric motors where they are exposed to dust in the mill. A small compressor, driven by an independent gas engine, is the source of starting air for the prime movers.

Recently, the plant on Gore Mountain has been amplified by the building of a grinding mill intended primarily to grind the garnet concentrates fine enough to be used in polishing plate glass—that is, to a fineness which is —200 mesh. Some idea of what this fineness means can be grasped when it is learned that the garnet will adhere to a window pane when thrown against it; and the garnet when so pulverized is no longer red or even pink but nearly as white as flour. In this annex, machinery is being placed which will be able to produce graded grains for a variety of industrial purposes, and these grains will range in size from —20 to —200. The capacity of the grinding mill will be 5 tons a day. Heretofore, the main mill has supplied the trade only with concentrates—each industry regrading and grinding the garnet to meet its own requirements.

The garnet products are hauled to the nearest railroad station at North Creek, 11 miles away. The first leg of the journey is a descent of 1,800 feet in 5½ miles; and Linn caterpillar tractors are used for this work. Supplies are carried back to the camp in the same way, and a round trip takes about seven hours. A tractor, with its trailer, can move 15 tons. At the present time the mill is turning out 20 tons of concentrate daily.

The camp is located in the midst of beautiful scenery, and is provided with comfortable accommodations and all conveniences required in a self-contained community of its type. There is a boarding house in which the dining room is large enough to take care of 150 people. The situation is a healthful one, and the winters are mild and the summers pleasantly warm.

Garnet papers were first used in the shoe trade for the shaping of heels and soles; and, today, in one big shoe factory more than 1,000 different garnet-paper forms are employed in heel and sole work. Garnet papers are at the present time extensively utilized in finishing the hardwoods used in making furniture, pianos, radio cabinets, wagons, automobiles, boats, railway cars, etc., and for smoothing floors, handles, and many kinds of mill work. Garnet papers of different kinds are found very serviceable in the finishing of metal products of various sorts; and the abrasive is also used for cleaning castings, for grinding valves, and for surfacing. Since 1914, garnet has been more and more used for the grinding of plate glass at the stage just before polishing; and there is reason to believe that garnet can be substituted to advantage for the quartz sand now utilized in sand blasting and in the cutting of marble blocks into slabs. Fine garnet papers are used in dental work; and the finest of these—in which the abrasive particles are hardly visible to the unaided eye—are employed in removing excess nap in giving silk hats their lustrous finish. Indeed, it is authoritatively declared that new fields of usefulness are likely to develop as a result of investigations now in hand; and the future of the abrasive garnet industry is said to be a very promising one.



Painting stucco by means of a paint-spraying outfit equipped with a small gasoline-driven compressor. Stucco is not only very destructive to bristle brushes, but it is difficult to give the rough surfaces a satisfactory coat of paint with brushes. For work of this kind the paint spray has been found to be especially suitable, as it makes it possible to apply the paint uniformly and to speed up the work. In other words, the paint spray does a far better job than the brush, and does it at a great saving in time.

PATENT DECISION RELEASES THE SAND BLAST

THE sand blast is a very efficient and satisfactory means for lettering and for producing various decorative effects upon stone monuments, etc., but its employment had been restricted of late by a pending suit brought in the name of the Phoenix Machine Company of Brooklyn, N. Y.—representing the Scantlebury patent—against the Empire Monument Company, Albany, N. Y. The case was heard in Albany in April, 1924. The animus of the complaint and the scope of the decision, which was recently rendered, are sufficiently explained in the words of the court, as follows:

First, that the defendant, the Empire Monument Company, has not infringed the Scantlebury patent.

Second, that anyone is free to do all and whatever sand blasting of memorials he pleases and to use hot composition or glue paper, whichever he may prefer.

Third, that the use of the sand blast for the lettering and carving of granite and marble is old—in other words, that such sand blasting was done long before Scantlebury's time.

RAILROAD WILL SOON TAP ROUYN GOLD FIELD

AFTER several months of negotiating, an agreement has finally been reached between the Quebec government, the Canadian National Railway, the mine owners in the Rouyn district, and the Rouyn Mines Railway Company for the construction of a branch from the Transcontinental Line to Rouyn Township.

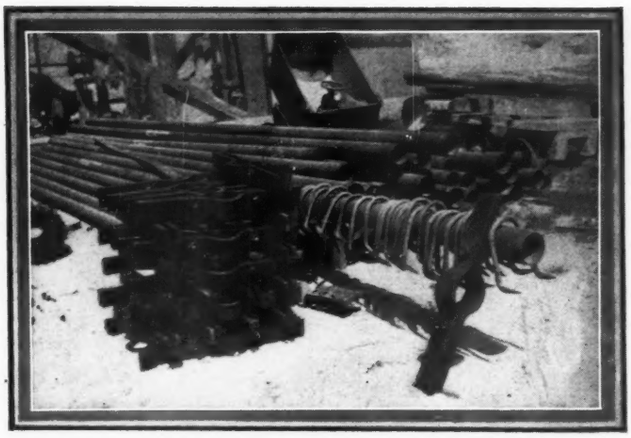
The railway is to be built by the Rouyn Mines Railway Company under the direction of engineers of the Canadian National Railway; it is to be 44.7 miles long; and will branch off from the Transcontinental Line at a point about 1¼ miles from O'Brien, Que. It is estimated that the entire cost of the work, including buildings, telegraph lines, track material, etc., will be anywhere from $2,500,000 to $3,000,000. The road is to be ready for service sometime during the autumn of 1926.

According to estimates made by government officials, more than 9,000,000 American tourists in 2,000,000-odd automobiles visited Canada during 1925. The outstanding facts in connection with this travel are that the tourists equaled in number the total population of Canada and that they put $150,000,000 into the pockets of the Canadian people.

Drill-Steel Sharpener Comes to the Rescue

By THE STAFF

THE truth of the adage that "Where there's a will there's a way" was aptly illustrated not long ago at the Buckeye Belmont Mines in Tonopah, Nev. A high-head pump had been acquired to take the place of several smaller pumps that had been used to lift mine water surfaceward by relays from the 1,500-foot level. With the new, powerful pump, the water is raised to the surface at a single lift. However, before the pump could be put into operation, 36 pairs of iron clamps—that is, 72 half clamps—had to be made to support the stress to which the long water column would be subjected. A hurry-up order for these bands was issued; and Paul D. McGuire, shop foreman of the Buckeye Belmont Mines, proved to be the man of the hour.



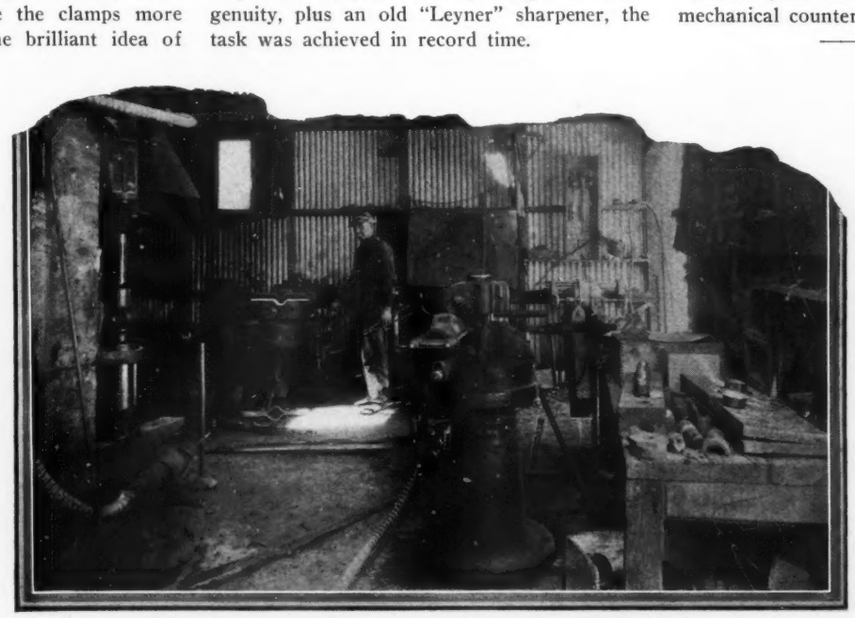
The 36 pairs of clamps which were made in record time.

The type of clamp generally used for this kind of work is nothing more or less than two pieces of strap iron, bent to conform to the size and to the shape of the pipe, with the ends drawn together by bolts. These ends rest on shaft timbers to help bear the weight of the pipe. Previously, the ends of each half clamp were heated and bent separately in a bench vice, and then the center was heated and bent around the horn of an anvil. In other words, three heats were required to produce a half clamp. In this way, it took the blacksmith and a helper nearly an hour to make a pair of clamps—and even then no two parts were alike.

But the resourceful shop foreman, while pondering a way to make the clamps more expeditiously, conceived the brilliant idea of die-forging them in a drill sharpener, of which there were three in the blacksmith shop. No sooner conceived, than he set out to execute his scheme. First, he went to the scrap pile, where he brought to light a piece of cast iron that had been used as a counterweight. Taking it to the machine shop, he had it grooved out on a shaper and drilled so that it could be bolted to the sharpener. This was his female die. The male die he had made in the blacksmith shop from a piece of strap steel.

With these preparations finished, Mr. McGuire was ready to go on with the principal part of the job—the forging of the clamps. As it was possible to heat from 15 to 20 clamps at one time in an oil furnace, all the clamps were turned out—without the assistance of a helper—with a single heat. The sharpener, being of an early type, was not equipped with punch and shears which probably could have punched the necessary bolt holes. So the blacksmith made a template and drilled the required number of holes in a drill press—forgetting, under the pressure of the moment, that a convenient air hammer would have served his purpose.

Be that as it may, the shop foreman was able to produce the 36 pairs of clamps in 1½ hours! Had he attempted to have the work done by the old method, the clamps would not have been ready in less than 10 days. Furthermore, the blacksmith would have needed a helper on the job. But, by using a little ingenuity, plus an old "Leyner" sharpener, the task was achieved in record time.



In the blacksmith shop of the Buckeye Belmont Mines, with Paul D. McGuire at the drill sharpener which he had especially fitted up for the forging of the clamps. Note the dies in position in the sharpener.

As for the character of the clamps so fashioned, they are smooth—showing no hammer marks, and are a perfect fit upon the pipe. But, what is of still more importance, they are alike—that is, it is possible to pick any two out of a lot and make a pair. No matter how the die-forged parts are put together, the bolt holes match. This is in striking contrast to the clamps made in the old-fashioned way; the halves so fashioned varied to such an extent that much time was wasted after they were finished in pairing them off.

At isolated mining camps, where it does not pay to dispose of scrap metal, some of this material can be turned into a variety of useful articles by a drill sharpener. For example, most mines buy track spikes and lag screws; and yet, with suitable dies for upsetting the heads, these spikes and screws can be made on a sharpener from old bolts and hanging rods. During the war, one large shipbuilding company on the West coast actually bought a drill sharpener for the sole purpose of turning scrap rivets into standard railroad spikes.

We are indebted to Mr. Letson Balliet, Consulting Engineer, Tonopah, Nev., for the information contained in this article.

An apparatus for mechanically determining the position of a ship at sea, according to *Commerce Reports*, has been invented by Mr. F. Nuschak, a retired Italian shipmaster. The arcometer, as the instrument is called, is a mechanical counterpart of the firmament.

A passenger steamer to be built on the Clyde will be the embodiment of advanced steam practice—the dominating feature of the vessel being the employment of steam at much higher pressures and temperatures than hitherto used. The boilers are designed for a pressure of 575 pounds, and they will be fitted with superheaters developing temperatures of from 700 to 750° F. Air heaters are also to be utilized to heat the air entering the combustion chambers. The contemplated pressures are said to be more than double those prevailing in marine service.

REDUCING LOSSES DUE TO RUST

By A. R. BURCHSTED

THE toll taken by rust is a subject that is avoided by many executives, as it does not seem to be of pressing importance; but this steady and positive source of depreciation is costing thousands of dollars yearly. There has been, in the past, some justification for this attitude of indifference to rust, because in many cases the cost of a rust preventative, plus the cost of its application, has not been much less than the cost of the damage due to rust. However, a recently developed method of applying an improved rust preventative has changed all this. By this means it is now far cheaper to prevent rust than to ignore it; and those in charge of metal materials stored out doors and exposed to the elements have been quick to see and to take advantage of this fact.

How a progressive railroad keeps exposed metal surfaces free from rust. By means of the specially devised air-operated spray gun, the rust preventative in the cylindrical container is applied quickly and without waste.

The rust preventative under consideration has been developed after several years of research in the Tide Water Oil Laboratories. It is a combination of mineral oil and rust inhibitor, and comes in three forms: a hard paste, a medium paste, and a liquid. After experimenting for a long time, it was found that the liquid form could be applied to the best advantage and most economically by spraying with compressed air. For this purpose, a small pistol-grip spray gun is used. This gun is connected by suitable hose lengths both to the main air line and to a small tank containing the liquid. There should be a reducing valve on the tank to regulate the force of the spray, as low-pressure air is usually sufficient for the best results.

The use of the gun calls for little skill, and an operator can handle it efficiently after a short period of practice. One gallon of the liquid will cover several hundred square feet of surface. However, before applying the rust preventative, the surfaces to be covered should first be cleaned with compressed air; and then, by a slight pressure of the finger on the pistol grip of the air gun, the oil can be sprayed readily on the surfaces of the material to be protected against the corrosive action of rust. If any spot is not completely covered, the oil supply may be shut off and another stream of compressed air blown over the uncovered surface. This has the effect of spreading the oil completely over all the surfaces and of forcing it into crevices and in back of and under such objects as tie and splice plates in railroad yards.

One very important feature of this rust preventative is that it works its way under any existing rust. That is, after the oil has been applied and pieces of rust have been scraped off the metal underneath will be found wet and dark. The rust preventative is very adhesive and will remain on surfaces after driving rain storms. Strange as it may seem, hot summer weather, with its frequent rains, is much harder on the preventative than winter with its snow, cold, and ice.

The accompanying picture shows how one of the large eastern railroads is using compressed air in waging its campaign against rust. The liquid and the air spray have been found especially suitable for service in railroad yards and in terminals located near salt water, or on roads carrying refrigerator cars. The oil can be sprayed easily and quickly on the sides of the tracks, on the tie plates, splice plates, signal pipes, metal storage bins, piles of stored materials exposed to the weather, etc. Railroads equipped with tie-tamping outfits can conveniently utilize their portable compressors for this work; and in some terminals small portable compressors would serve the purpose and do so to good effect.

SUBMERGED FLAME USED TO RAISE STEAM

PRESS reports have it that steam can be generated by burning an oil flame right in the water from which steam is to be raised. Who the inventor of the new boiler is or where it is made are not revealed; but it is said that compressed air is used in connection with this new system of steam generation.

When starting operations, the level of the water is below that of the burner. This burner is secured to the end of a pipe that projects into the water space of the boiler. Not until after the burner is lighted is the water permitted to rise high enough to submerge the flame. Here is where compressed air probably comes into play, as it is not only necessary to supply oxygen to the flame but also to produce a gaseous cavity within the water in which the steam-raising flame can burn.

Among the advantages claimed for the system are: the fuel is consumed without waste; there is neither smoke nor soot; the heat, instead of causing all the water to boil, vaporizes only that portion of the water immediately in contact with the flame—the steam so produced rising immediately to the surface and passing into the steam dome; stoking is mechanical; and the equipment requires little floor space.

ICE FORMED OF MYRIADS OF CRYSTALS

A BLOCK of clear, hard ice gives no hint of its complex interior; but C. F. Talman, of the United States Weather Bureau, tells how it is possible to get a sight of the myriads of beautiful starry crystals of which it is composed. One method is to rub the surface of the ice with a soft lead pencil or to dust it lightly with soot by means of a soft brush. The substance so applied fills the slight depressions between neighboring crystals and discloses the outlines. A coating of soot can be similarly used to bring out the details of frost figures formed on window panes. Another way of bringing out the crystals consists of passing a beam of light through a thin slab of ice and projecting the image on a screen, or of focusing the beam upon a point inside the slab and then watching that spot through a magnifying glass. In either case, little shining figures appear in the shape of 6-petaled flowers, each of which represents an open space in the ice where a crystal has been melted by the heat of the beam and left the shape of the crystal. This space is nearly filled with water; but, as the ice contracts in melting, a tiny bubble-like vacuum is left at the center of each flower. The spaces and their contents have been called "negative" or "inverse" crystals.

Shellac, a ready varnish universally employed and also a valuable insulating material, has one disadvantage—it becomes brittle as it hardens. If 10 to 15 per cent. castor oil be added to the shellac after it has been dissolved in alcohol the shellac will remain flexible after drying.

Getting Out the "Toughest Rock On Record"

Oil Engine Compressor and Modern Drilling Equipment Contribute Largely to Unusual Success of English Quarry

By EDWARD DALTON*

IN THE present period of intense competition in well-nigh every department of industry, operating economies become matters of prime importance to any alert management.

The accompanying article describes how very substantial savings have been effected by a progressive British rock-products company through the adoption of thoroughly up-to-date equipment. Among these facilities might be mentioned a direct-connected, oil-engine-driven compressor. Largely through the installing of this unit, the company is now able to produce a ton of rock at only 25 per cent. of the cost formerly believed to be a reasonably low one.

"GOOD ROADS" is not a slogan confined to America and other of the so-called "new" countries. It is now a universal phrase. Every nation realizes only too well that good roads with wide, hard, and lasting surfaces, with proper gradients, and with correct curvatures, are essential not only to the comfort of the people but to the defense of the realm. The increased use of the motor car for pleasure and of the motor truck for transportation may be considered the outstanding causes for the extent of the present-day road programs.

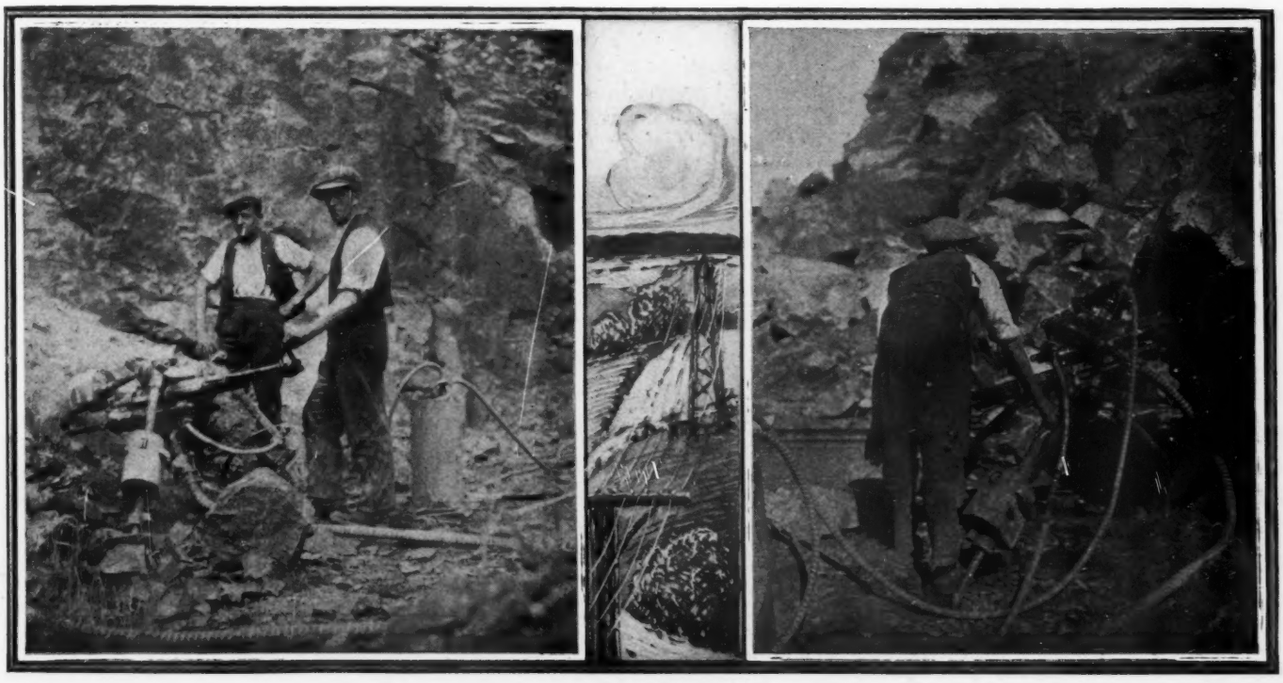
The British Isles have long been famous for their good roads. In fact, the slogan must be altered to "Better Roads" when used in reference to the highways of these historic islands. The example set by the Romans—those first builders of real highways—has been studied and followed throughout the long span of Britain's existence. A poor road there is uncommon; and yet the present road program is the largest in its history.

The reason for this extensive roadbuilding program is best made plain by a study of the increased registration of motor vehicles in the British Isles. In November, 1921, there were registered 25,000 pleasure cars, 135,000 commercial vehicles, and 76,000 hackneys. In 1923 these figures had been increased by 40 per cent., and in 1924 there was a further increase of nearly 20 per cent. On May 31, 1925—this being the date of the last quarter for which figures are now available, there were registered 532,909 pleasure cars, 216,966 commercial vehicles, and 92,024 hackneys, representing a gross increase over 1921 of 83 per cent.

Most of the moneys are being spent to improve existing highways, to widen out narrow roads, to reduce gradients, to eliminate heavy curves, and to provide adequate drainage. This naturally calls for resurfacing and rebuilding; and, wherever possible, the hardest and toughest rock is being used. So, as is always the case, the road problem resolves itself into one of quarries, rock drilling, blasting, and crushing. The cost of building these better roads can only be in line with the cost of "getting out the rock," and to the informed this phrase is synonymous with "compressed-air-operated rock drills." The purpose of this article is to show how one British quarry has solved this problem to the profit of the owners and to the benefit of the country. We refer to the Scatter Rock Macadams, Ltd., in Devon, a quarry producing what is popularly known as "the toughest rock on record."

About ten miles from Exeter, one of the principal cities of Devon, is the little village of Christow. This typical Devon village is situated on a hillside about one mile from the railway station. Above Christow are the work-

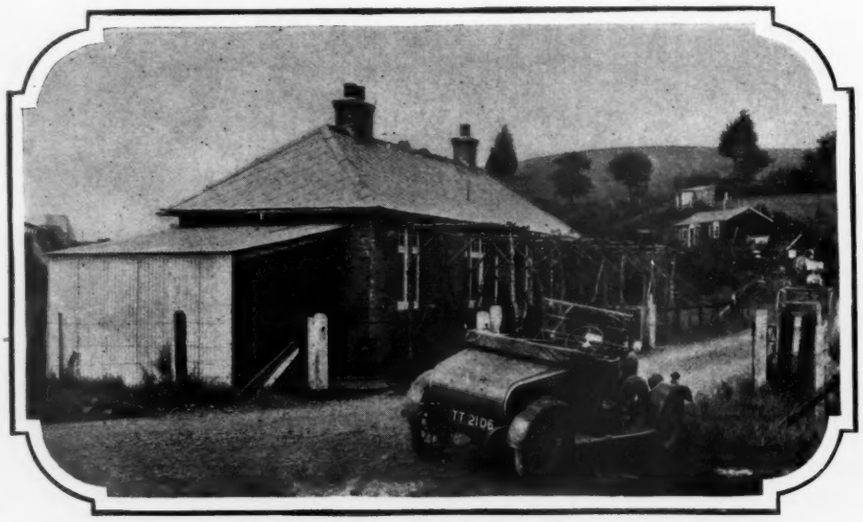
General Manager, Scatter Rock Macadams, Ltd.



Left—An X-70 drill putting in horizontal toe holes.
Right—An X-70 drill used for block-holing large boulders.

ings of the Scatter Rock Macadams, Ltd., where there is now installed one of the most modern and efficient rock-drilling plants in England.

The quarry was opened up about 12 years ago. Ever since that date it has been supplying crushed stone and screenings for macadam road work. It might be well to mention here that hard macadam is still the most popular type of road in the British Isles. While many countries have recently specified concrete as the road for heavy traffic, British engineers have not committed themselves to the same extent as have others to this type of highway. The macadam surface, usually mixed with tar before application, is still the "Class A" road. Hence there has always been a heavy demand for hard or tough macadam rock; and the quarry in question has supplied a great tonnage of this material for roadbuilding. Its quality as a surfacing stone is best expressed in the slogan of the quarry.



Office of Scatter Rock Macadams, Ltd.

This very quality of toughness has made it difficult and expensive to quarry and to market the product with a fair profit at competitive prices. Although rock-drilling machinery has been used practically since the opening of the quarry, the management, in 1924, saw the need of a new plant which would be modern in every sense of the word. In this way only could output be increased and production costs reduced. At that time, namely September, 1924, a change was effected in the active management of the quarry, and recommendations for a new plant were made.

Prior to that date, the rock-drilling equipment consisted of two F-24 Sergeant reciprocating or piston drills; two BCR-430 "Jackhamers"; one each of the DCR-13 and DDR-13 "Jackhamers"; a No. 5 "Leyner" drill-steel sharpener; and a No. 24 Ingersoll-Rand oil furnace for heating the drill steels. Compressed air was furnished by a 12-inch bore by 10-inch stroke, single-stage, double-acting air compressor. A 160-B.H.P., semi-Diesel, 2-cycle, 2-cylinder oil engine, operating at 160 revolutions per minute, still furnishes power to run the crushers, the elevators, and the screens, as well as to assist gravity in the operation of an aerial ropeway. Before the installation of the new plant, which will be described later, the engine also furnished power for driving the air compressor by means of belting. This engine was in a power house built on a hillside adjacent to the quarry mill.

The rock is drilled and blasted in the quarry and delivered to the main quarry mill, where it is crushed and screened into 2¼-inch and 2-inch sizes. From this point an aerial ropeway transports the crushed stone to a granulating mill located on a large siding of the Great Western Railway System. At this latter mill the finished road metal—the 2¼-inch and 2-inch sizes—is delivered direct from the ropeway into the railway wagons. All outsizes rejected by the quarry mill are also transported to the siding mill, where they are crushed and screened to chippings, that is, to ½-, ⅜- and ¼-inch sizes. These chippings are then dumped into wagons—each of which bears the company's slogan—and carried to their final destination.

The aerial ropeway deserves a short description, as it is one of the most successful installations of its kind in the neighborhood. In length it is just short of one mile, which gives the reader an idea of the distance separating the quarry from the siding. There are two angle stations along the ropeway; and all highways over which the ropeway passes are covered and protected. All told, 72 buckets are used—36 empties going up to the quarry and 36 fulls bringing the rock to the granulating mill or railway wagons. Wire-lock cable, manufactured by Latch & Batchelors, is employed. The loaded rope is 3 inches and the empty rope 2 inches in diameter, while the traction rope is, of course, smaller—being approximately of ½-inch diameter. This wire-lock cable is a safeguard, as its construction is such as to prevent unraveling of the cable in case of breakage. It was previously mentioned that the oil engine is connected to this ropeway through the mill lineshaft; but its power is required only to assist gravitation and to insure steadier operation. The sturdiness of this aerial ropeway and the soundness of the design can best be understood when it is known that it was put in service in 1912 and has been in steady use ever since.

The new plant, which was installed in the latter part of 1924, comprises far more up-to-date and efficient machinery than that which it replaced. Based on results secured in other quarries, the management decided to substitute a heavy type of hammer drill for the piston or reciprocating drill used for deep-hole drilling. The "Jackhamers," which were of modern construction, are still in operation. In order to insure better drill steels and better drill-steel bits and shanks, a new No. 50 "Leyner" drill-steel sharpener was purchased. The old No. 5 machine had done good service; but the day had come when a new and a more powerful sharpener was essential. At the same time, in order to make the sharpening plant modern in every sense of the word, a No. 25 I-R oil furnace was purchased to replace the older No. 24 furnace.

In middle distance can be seen the piers which support the aerial ropeway.

It was realized that a plant of this size, installed because of its greater efficiency, would not be complete without an air compressor which could furnish the needful power at the lowest possible cost. Every type of compressor was considered, and actual cost analyses proved beyond all question that the direct-connected, oil-engine-driven air compressor was the logical ma-

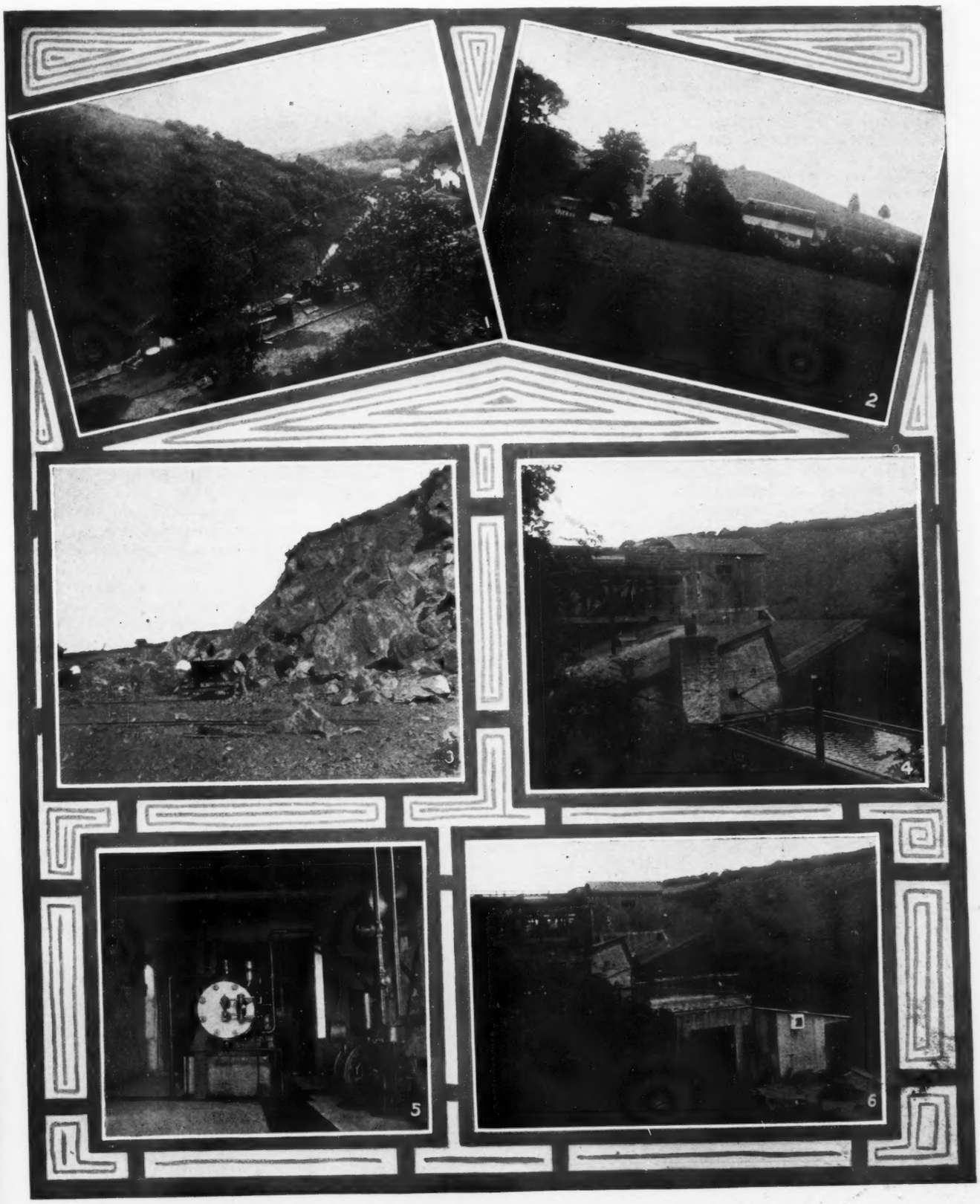


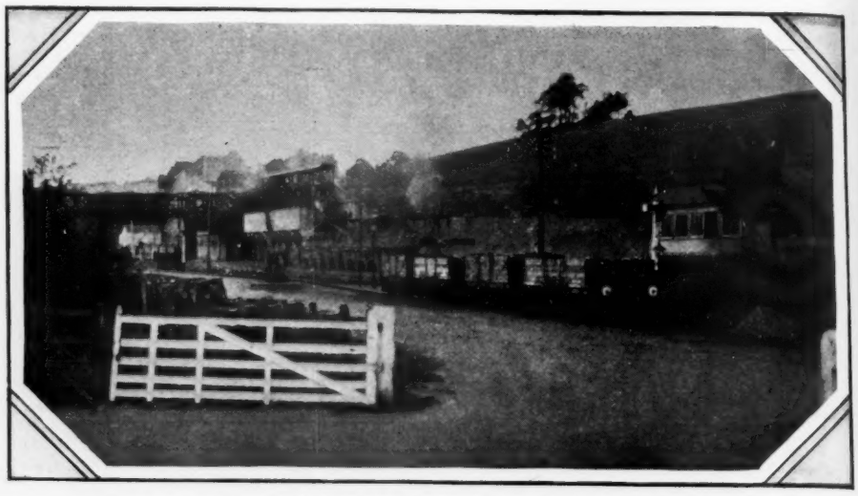
Fig. 1—Aerial ropeway which conveys crushed stone from the quarry to the granulating mill.
Fig. 2—Granulating mill of Scatter Rock Macadams, Ltd.
Fig. 3—Loading cars with rock after a blast in the quarry.
Fig. 4—Cooling-water tank for the oil engine is located on the roof of the engine-room.
Fig. 5—Engine-room showing the POC-2 unit and the starting air compressor.
Fig. 6—An inclusive view of the crushing house and the oil-engine room.

chine to install. Accordingly, a unit of this type, having a piston displacement of 603 cubic feet per minute, was purchased.

Before analyzing the performance of the new compressor, it might be well to review the savings which have been effected by the new hammer drill, the X-70 drifter, which is essentially a deep-hole machine. For the work for which it is used at the quarry this drill is ideal, as it combines fast drilling speed and low air consumption with strong rifle-bar rotation. The essential differences between the piston or reciprocating drill and the hammer drill are as follows: the hammer type of drill is so constructed that the blow delivered to the drill steel is like that delivered by the hand hammer except that the blow is mechanically applied. All the energy of the moving piston is applied through the drill steel to cut the rock. As the drill is not fastened to a reciprocating piston, the drill is not robbed of its energy in overcoming friction and inertia. On the contrary, the drill rests loosely in the chuck and is struck by the hammer blow of the piston. Inasmuch as the drill bit is held closely to or against the rock at all times, the weight moved is that of the hammer alone and is light and constant at all times regardless of the length of the drill steel. As used at Scatter Rock Macadams, Ltd., the drill is mounted on a tripod; and most of the holes put in are what are known as down holes.

With the old F-24 piston drill the average drilling speed was one 20-foot hole per drill per day of 8¾ hours. The starting bit was 4½ inches in diameter, and the hole was bottomed at 20 feet with a bit 2¼ inches in diameter. The variation in gage of successive steels was ¼-inch. With that piston drill it was possible to drill only down holes.

The X-70 puts down a 20-foot hole in the hardest rock in the quarry at an average rate of 2 hours and 55 minutes, or in one-third the time required by the old piston drill. Although most of this increased footage is the result of the faster drilling speed of the X-70 machine, some of it is due to the fact that it is possible, because of the No. 50 "Leyner" sharpener, to use steels having a variation in gage of ⅛-inch. The starter bit now employed has a diameter of 3 inches, and the hole is bottomed at 20 feet with a 1¾-inch bit.



Granulating mill located on a siding of the Great Western Railway.

Another advantage of the X-70 is that it can be used for drilling a series of half upper holes. This has made possible more systematic blasting. As a result, since these machines have been put in service, the total production per drill has been increased approximately 400 per cent., and they have also brought about a large annual saving in the amount of powder required for blasting. The powder now being used is known as "Sabulite."

Of course, such great increases in drilling speed not only call for the very best of drill steels but for the most careful treatment of these steels. The management has selected hollow, round, "Sandvik" steel for its drills. This steel is rolled on a mandrel which assures a uniform hole right in the center of each steel; and the sharpener and the oil furnace together have made feasible a systematic and a thorough preparation of all the steels used in the quarry. Besides sharpening each steel in a fraction of the time heretofore required by hand methods, the sharpener is the only means of making drill bits and shanks that will stand up under service.

The remarkable savings mentioned should, it seems, be enough to satisfy any quarry; but they really represent only half the story. Records of the performance of the new oil-engine-driven compressor tell an equally remarkable tale; but, at this point, a short description of the machine, itself, would probably make the reasons for its adoption clearer to the reader.

The crushing house.

The machine, known as Ingersoll-Rand Type POC-2, is a 2-stage compressor direct connected to a single-cylinder, 4-cycle oil engine. One of our photographs shows the external appearance of this machine, while another illustrates its internal construction and arrangement. A glance will show that a compressor of this type has a number of points which might have appealed to the quarry management. For example, direct connection of engine and compressor not only avoids belt and other transmission losses, but the manner in which the air end is constructed and connected is such as to require a minimum of floor space. At Scatter Rock quarry this matter of floor space is one of real importance, as the facilities of the existing hillside plant are limited.

The new drilling program called for greater compressor capacity than was available. In fact, a compressor of about 500 cubic feet of free air actually delivered per minute was necessary. It was impracticable to enlarge the power house to accommodate a 100-H.P. engine belted to a 2-stage compressor of either duplex or tandem construction. Then, too, experience with a belted, single-stage compressor had convinced the management that the more economical 2-stage compressor was desirable, and that, if possible, the belting with its attendant losses and up-keep costs should be eliminated. Both faults are remedied in the POC-2 machine, which has brought about an overall saving of approximately 20 per cent. in the power required to drive the compressor.

Other features of the new unit are the construction and the performance of the oil-engine end. As heretofore mentioned, the first engine was of the semi-Diesel type. At the date of its installation this engine was about the best available for the service; but more recent improvements in oil-engine practice precluded the selection of another semi-Diesel type. Briefly, the new engine is of the single-cylinder, solid-injection, 4-cycle type. The fuel is injected into the combustion chamber of the cylinder by means of two opposed spray nozzles to which oil is delivered under pressure by an injection pump. Ignition is by heat of

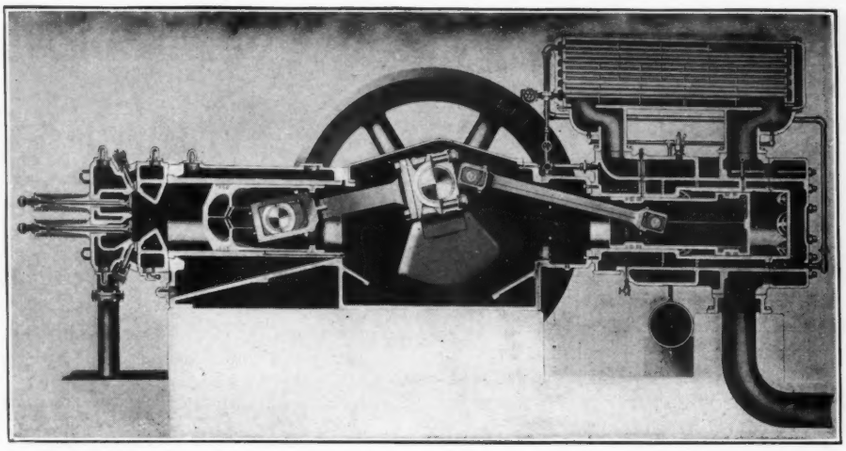
compression only, and the engine starts cold. The starting air is supplied by means of a small gasoline-engine-driven compressor, which pumps air at approximately 200 pounds pressure per square inch into an air flask. It is not necessary to operate this gasoline-engine-driven unit for every start and stop, as the oil engine, itself, is provided with a check valve which charges the air flask direct from the compression of the engine. Ever since the engine was installed it has never failed to start quickly—usually within two revolutions.

Quarry work calls for a compressor which can readily adapt itself to changes in load. These variations in the amount of air required are taken care of by means of an automatic system of regulation with which the air compressor is equipped. Of course, the output of the compressor can be varied by changing the speed of the engine—a simple act which can be performed while the engine is running.

The rating of this oil-engine compressor is: piston displacement, 603 cubic feet per minute; actual delivered capacity, at 100 pounds discharge pressure, 475 cubic feet of free air per minute.

Careful records kept of the performance of the engine show that the fuel-oil consumption of the engine is between .39 and .40 pound of fuel oil per brake-horsepower-hour. The average load on the engine is 75 per cent. Anglo-American Diesel fuel oil is used, and this oil has a heat content of approximately 19,400 B.T.U.'s per pound. This fuel-oil consumption, which is below that guaranteed by the manufacturer, is not even as startling as the lubricating-oil consumption. The records show that the engine is using 1 gallon of lubricating oil per 4,800 rated horsepower-hours. This remarkable record is probably due to two facts: the pressure-feed system of lubrication and the Vacuum Oil Company's "DTE" oil which is being used.

The foregoing figures will probably interest an oil-engine expert more than they will the average quarryman, who is primarily interested in how much it costs him to produce a ton of rock. This is a question which can be answered only in the terms of the entire plant, that is, it is a gage of the overall efficiency of the drills, drill steels, method of putting down the holes, blasting, and cost of compressed-air power. At Scatter Rock, the plant described has made it possible to produce a ton of rock at approximately 25 per cent. of the previous cost.

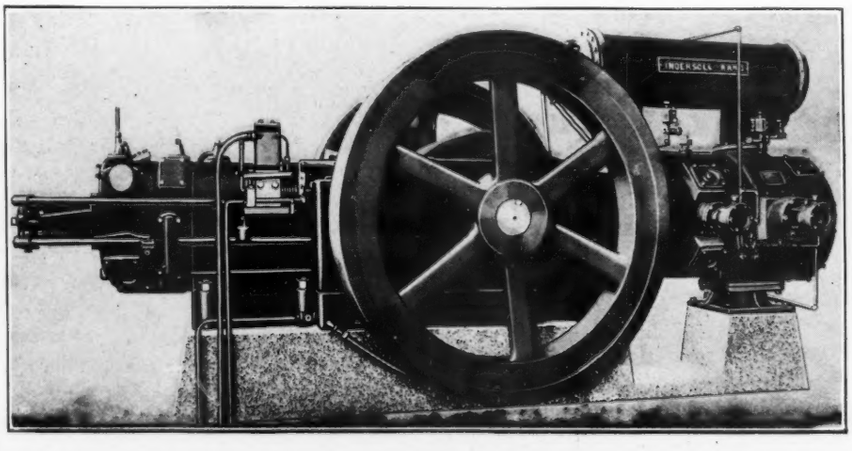


Longitudinal section of the compressor unit giving full details of design and arrangement.

Another feature of interest is that the oil-engine compressor requires 1 gallon of fuel oil per 9.22 tons of rock, and 1 gallon of lubricating oil per 535 tons of rock. When the new compressor was installed, the belt-driven air-compressor load was taken off the existing semi-Diesel engine which is now used to drive only the mill shaft operating the crushers, screens, elevators, and aerial ropeway—a load of about 100 B.H.P.

One of the illustrations indicates the cooling-water system used for both engines. This consists of a tank, built on the roof of the building housing the POC-2 unit, of a small spray, and of a circulating water pump driven direct from each engine.

The present capacity of the Scatter Rock Macadams, Ltd., is 75,000 tons per year. The greater part of this rock is sold to contractors and to municipal and county engineers for roadbuilding. Recently, however, a new line has been undertaken. The company has associated itself with contractors and engineers in the production of tar macadam, and the demand for this material is increasing rapidly.



Type POC-2 oil-engine compressor installed at the quarry.

RECORD GAS MAIN

AFTER three years of work, there has recently been completed, in Chicago, at a cost of $4,000,000, a gas main 48 inches in diameter and 22 miles long. This main—the longest of its kind in the world of so large a diameter—is made up of 9,500 sections of cast-iron pipe, each 12 feet long, weighing 382,000 tons. Special concrete tunnels 9 feet in diameter had to be built under the Chicago River and the Drainage Canal to carry the line.

When the conduit was ready to be put in service, it was of course full of air which, when admixed with the inflowing gas, temporarily formed an explosive mixture. As this might have been fired by a stray electric spark, or otherwise, great care had to be exercised to prevent an explosion. At this critical time, chemists made 5-minute tests of the contents for a couple of hours until 100 per cent. of gas was shown. Then all danger was passed. The line will easily distribute 100,000,000 cubic feet of gas a day, and possibly carry double that volume when service demands increase.

ART OF WELDING ADVANCES

THE art of welding iron and steel has made great strides within a very short period; and the difficult and more or less unreliable processes of the blacksmith have given way to methods that make for speed, reliability of performance, great reduction in cost, and an incomparably wider range of usefulness. Its most astonishing application is, perhaps, in the construction of airplanes, the skeleton frames of which often consist of light steel tubing with all joints welded. At a recent steel-treater's convention, held in Cleveland, a welder was kept busy welding firebox plate into test pieces which were ground to normal thickness and pulled in a testing machine. These pieces always broke elsewhere than at the weld.

A new local anaesthetic called "psicain," developed by Professor Willstaedter of Munich, is said to be the nearest approach to cocaine yet discovered.

Air Drill Makes Repairs Possible Miles Away From a Machine Shop

By C. A. BARDON*

IN OPERATING a general machine shop, where not only new but general repair work is done, one has a variety of knotty problems to contend with in the way of working up special jigs, tools, etc., to facilitate such repairs. The writer had a repair job put up to him a short time ago which not only called for a certain amount of work to be done in the shop but for a very special and important part to be carried out in the field.

This repair work was on the drive of a 4,000,000-gallon pump for the Butte Water Company of Butte, Mont. The pumping plant is located some 30-odd miles southwest of Butte, on the Big Hole River. The pump is driven by an 800-H.P. motor with herringbone pinions on each end of the extended rotor shaft. As the pinions held the rotor rigid, the rotor had no chance to float in the field; and in the operation of the pump trouble was experienced because the outboard bearings heated and the pinions had a tendency to climb on the larger herringbone gears. After consulting with company officials and engineers, it was decided to install flexible couplings between the rotor and the pinions. A compression spring coupling was made. One half of it was pressed and keyed on the shaft while the other half, with pinion attached, floated on the rotor shaft.

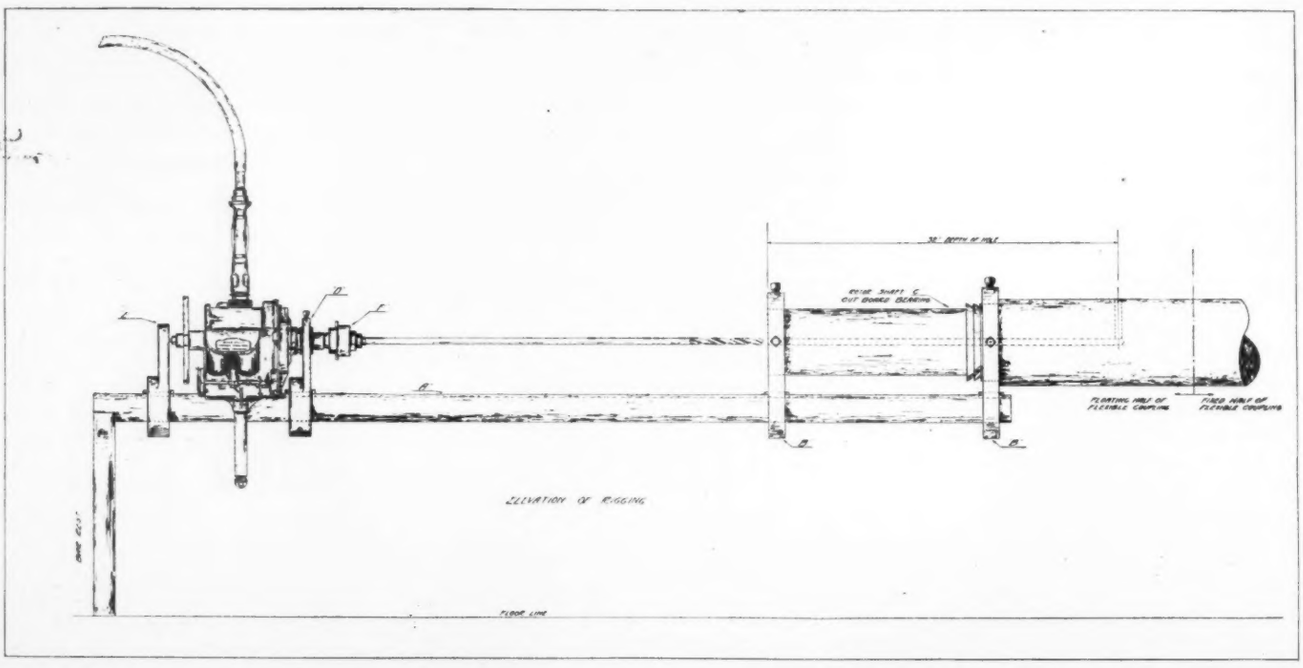
Lubrication was provided for the coupling, but it was not a positive or a force-feed system. After a few days' operation it was definitely decided to employ positive-gravity and force-feed lubrication combined, so that if the gravity system should fail the forced-feed system could be relied upon.

To provide for this lubrication it was necessary to drill an oil hole, 32 inches deep, in each end of the rotor shaft and at those points that connect the holes with the surface of the shaft. After the oil was fed in the ends of the shaft, either by gravity or hand feed, it would then be forced by the rotation of the shaft into the counterbore or oil pocket of the loose half coupling.

To save time and the big expense of trucking the heavy rotor and the shaft some 40-odd miles through the mountains to the machine shop of the Anaconda Copper Mining Company, at Anaconda, it was decided to do the work in the field. The power and the equipment available at the site consisted of air at from 60 to 90 pounds pressure and of an air drill. Just how the work was done and the rigging used are plainly shown in the accompanying sketch.

The main supporting bar, A, was made from cold-rolled shafting, which was splined throughout its entire length. Two steel clamps, B, were connected to bar A with taper keys and secured to the main rotor shaft, C, by set screws. The air drill was supported on bar A by a steel bracket, D, and a back-rest bracket, E. These brackets were machined to a free sliding fit on the bar and kept in alignment by a gib key.

In order to prevent the breakage of the drills a safety friction chuck, F, was used. The drills were of carbon steel, with No. 2 Morse taper shanks and with recesses for deep drilling, and they were ¾, 11/16, ⅝, and 9/16 inch in diameter and 10, 20, 28, and 36 inches in length, respectively—each size drilling to a depth of 8 inches. The time required to drill both ends of the shaft was approximately 16 hours, which included setting up and taking down the equipment. The alignment of the holes was as true as if the work had been done in a shop, where suitable machinery, etc., would have been available. It might not be out of place here to add that I-R pneumatic tools are used almost exclusively in our shops; and the foregoing application is but one of the many ways in which they can be put to service.



General arrangement of rigging used in adapting the air drill to an unusual service. A, main supporting bar; B, B, steel clamps; C, main rotor shaft; D, steel bracket; E, back-rest bracket; and F, safety friction clutch.

*Machine-shop foreman, Foundry Department, Anaconda Copper Mining Company.

Rapid Progress on Broad Street Subway in Philadelphia

Standardized Equipment and Use of Highly Efficient Methods Have Enabled Patrick McGovern, Incorporated, to Make Astonishing Headway

PART III

By ROBERT G. SKERRETT

WHAT might be described as the northern half of the Broad Street Subway is being constructed by Patrick McGovern, Incorporated, of New York City. The work embraces the building of 16,641 linear feet of 4-track subway and the completing of a terminal yard which will occupy an area of 31 acres. The terminal yard, besides providing for the storage of 450 cars, will have shops and associate facilities capable of repairing and maintaining substantially 600 cars. The combined contracts represent a total obligation of $25,800,000.

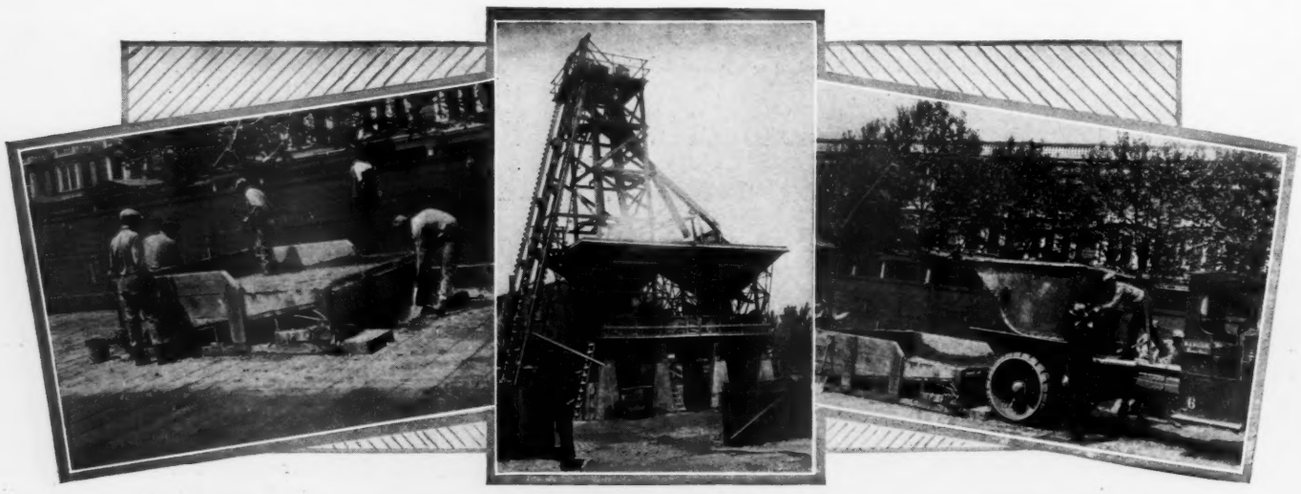
The manner in which Patrick McGovern, Incorporated, is doing the work awarded it presents a number of very interesting angles from an engineering point of view. And the methods employed by this experienced and resourceful firm make plain how the company has been able to forge forward at a remarkable rate notwithstanding the magnitude of the job and the fact that the subway is advancing beneath one of Philadelphia's busiest thoroughfares.

Close-up of paving breakers attacking the asphalt surface of Broad Street.

Before entering into a description of the means and the methods used by the contractor, it might be well to give some particulars regarding the several contracts constituting the McGovern part of the entire undertaking. On September 15, 1924, bids were asked by public advertising for the construction of that portion of the Broad Street Subway extending from Clearfield Street on the south northward to a point 45 feet beyond the intersection of Courtland Street. This section of the subway covers an interval of 8,591 linear feet and connects at its southern end with the north end of Contract 105-B, which terminates at Clearfield Street. Patrick McGovern, Incorporated, was the successful bidder; and the contract—officially known as 106—was signed on October 27, following. Work under Contract 106 was started about November 17, 1924; and the contract price was $14,300,000.

Besides calling for the construction of nearly 8,600 linear feet of 4-track subway, Contract 106 includes the building of three stations located, respectively, at Allegheny, Erie, and Hunting Park avenues, together with the doing of certain appurtenant work consisting of substantially 3,500 linear feet of main trunk sewers to be built off line or to be reconstructed—the sewers ranging in size from 9x11 to 15x17 feet in rectangular cross section; the removal and the relocation of water mains, gas mains, electric conduits, telephone lines, etc.; the underpinning of flanking structures along the route wherever such support should be necessary; and the supporting, maintaining, and underpinning of the Richmond Branch tracks of the Reading Railroad where those

Portable compressors and air-driven paving breakers have proved invaluable aids in the early stages of excavating for the Broad Street Subway.



How concrete is mixed, transported, and delivered to underground points by Patrick McGovern, Incorporated.

tracks cross the line of the subway near Kerbaugh Street.

Contracts 107-A and 107-B were bid in on August 18 of the current year and were awarded Patrick McGovern, Incorporated, the next day. Work on Contract 107-B was started twelve days later, and work on Contract 107-A was begun during the past month. Contract 107-A carries the subway northward from Courtland Street to a point a little beyond Chew Street, a distance of 6,300 feet; while Contract 107-B embraces the extension of the subway north from Chew Street to Grange Avenue, where the route turns eastward on Grange Avenue and runs to the Fern Rock Terminal Yard. This contract will involve the building of 1,750 linear feet of subway and the constructing of the shops and the associate features required to complete the big terminal. The combined price for the work covered by Contracts 107-A and 107-B is $11,500,000.

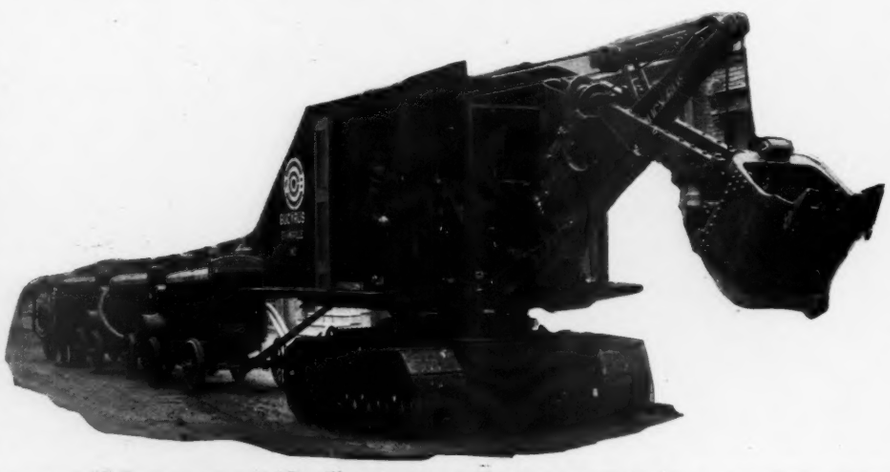
Exploratory borings made along the section covered by Contract 106 disclosed that the contractor would have to remove substantially 50 per cent. of rock in excavating the subway prism. The contractor subsequently found that the formation was made up of approximately 70 per cent. mica schist and 30 per cent. hard rock. Realizing that the removal of the rock would probably necessitate much drilling and blasting, Patrick McGovern, Incorporated, wisely conducted a series of competitive tests before selecting the drilling equipment. As a result of this, the BBRA-13 "Jackhamer" was chosen. This type of drill was needed because it can drill rapidly and keep the drill hole clear when penetrating the relatively soft and clogging mica schist. The BBRA-13 is a "Jackhamer" that has been especially designed to give exceptionally strong blowing action when at work. This feature of the tool is essential to success when the drill is employed on ground of the character just referred to.

The contractor is outspoken in his praise of the service performance of the numerous BBRA-13 "Jackhamers" which he has used to date on Contract 106, and frankly declares that no small part of his rapid progress in getting rid of rock has been due to these drills.

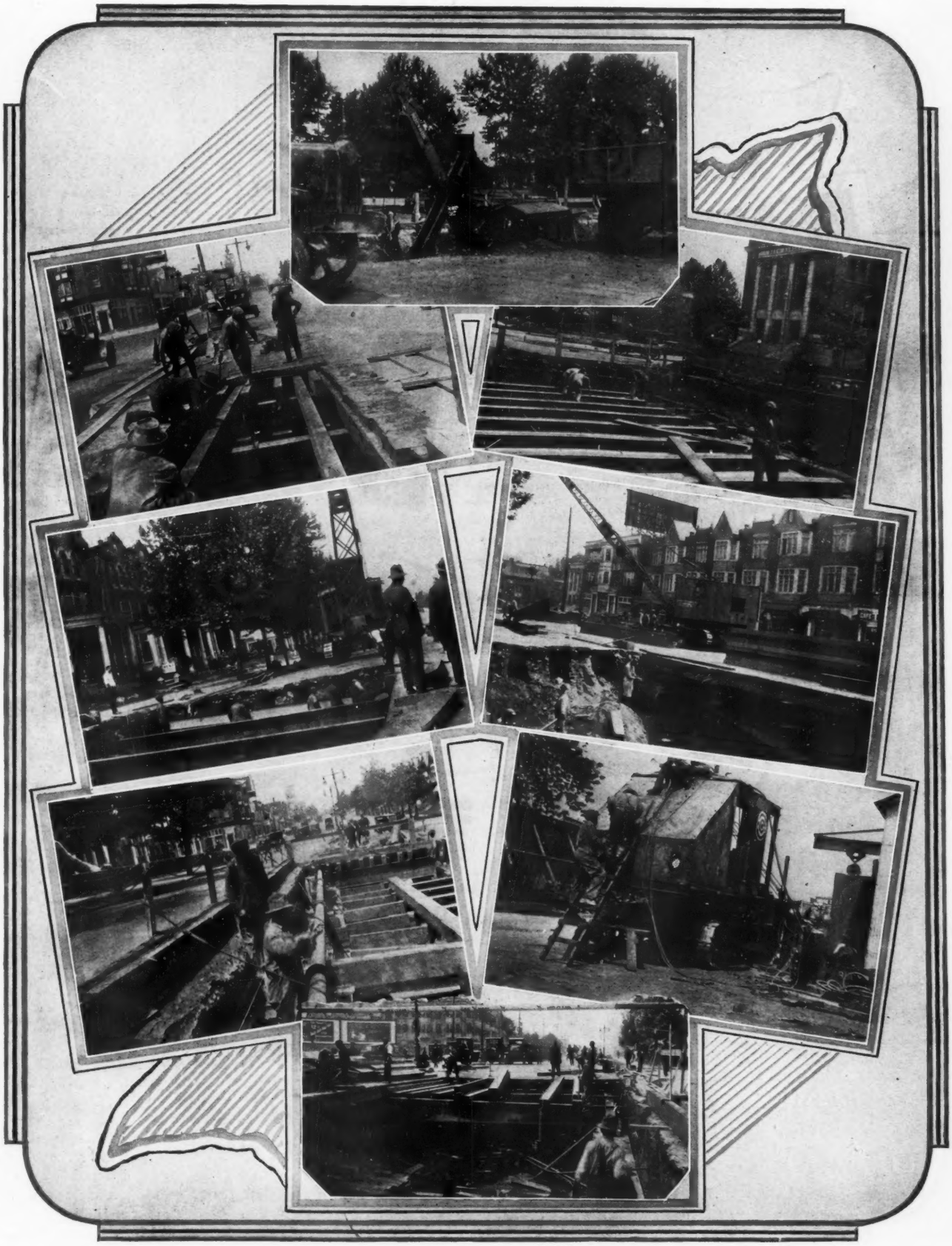
The prosecution of work on Contract 106 has been distinguished by the standardizing of the procedure followed. That is to say, from end to end of the section, a carefully planned method has been employed. This has made it possible to coördinate operations at the different points of attack, and has so systematized activities that there has been little, if any, lost motion. In short, the engineering staff of Patrick McGovern, Incorporated, has profited by ripe experience and has utilized methods and facilities which promised from the very start to help towards a speedy accomplishment of the task in hand. Perhaps it would be easier to grasp just what has been done by the contractor if we mention a few of the outstanding features of the job.

In excavating the subway prism for Contract 106, it has been necessary to remove 700,000 cubic yards of earth and rock; to place 85,000 cubic yards of concrete; and to erect 10,000 tons of steel forming the permanent structure which supports the overlying highway. In carrying out this work, and in doing certain associate work previously mentioned, the contractor has been obliged to deck over Broad Street in such a manner as to interfere as little as possible with the normal flow of heavy traffic along that thoroughfare. Notwithstanding the magnitude of the task, Patrick McGovern, Incorporated, at the end of only ten months after the start of operations, had the contract 80 per cent. completed.

The manner in which the work has been carried forward has been notable in a number of respects. In decking over the street, the contractor elected to deck over two-thirds of the width of the street in the first place—thus leaving the remaining third of the roadway clear for traffic; he has used ramps instead of shafts to facilitate the removal of spoils—the ramps permitting motor trucks to go underground and to carry off the excavated material directly from the headings; he has adopted a system of bracing for the decking that has insured an exceptional amount of head-room immediately above the floor of the excavation; he has employed air-driven shovels to do the mucking and to load the fleet of motor trucks; and he has utilized air-operated rock drills and other pneumatic tools wherever practicable to lighten labor and to speed up progress. It might be mentioned here that pneumatic clay diggers and paving breakers have been found very effective in getting out not only the clay but much of the de-



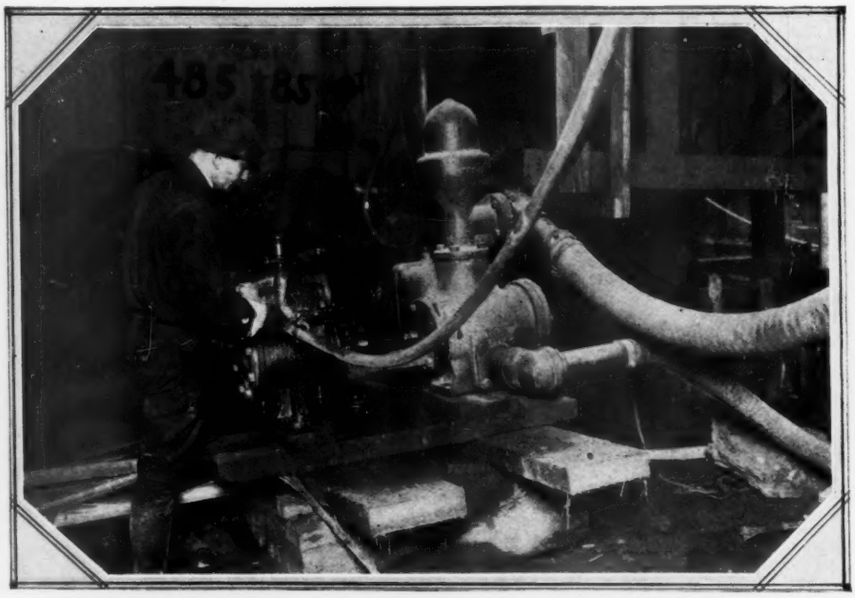
How three I-R portable compressors furnished motive air for a caterpillar shovel which, in its turn, pulled the compressors after it.



Snapshots showing different surface activities in connection with the methods employed by Patrick McGovern, Incorporated, in digging the Broad Street Subway.

composed mica schist encountered.

The method of decking and the nature and the dimensions of the materials used are indicated by an accompanying drawing. Broad Street is 69 feet in width from curb to curb; and the east side of the street, for about 80 per cent. of the length of the section included in the contract, was decked over for a width of 45 feet before any of the decking was done on the remaining west side of the street. The decking was supported in the main by I-beams ranging in depth from 24 to 30 inches and varying in length from 45 to 55 feet. Underlying and tied to these beams was disposed the truss bracing, which has served to hold the flanking sheeting in place against inward movement of the outlying walls of the excavation. All told, about 13,000,000 board feet of Oregon fir was used in the timbering and the decking, and quite 5,000 tons of steel was required in the temporary structure.



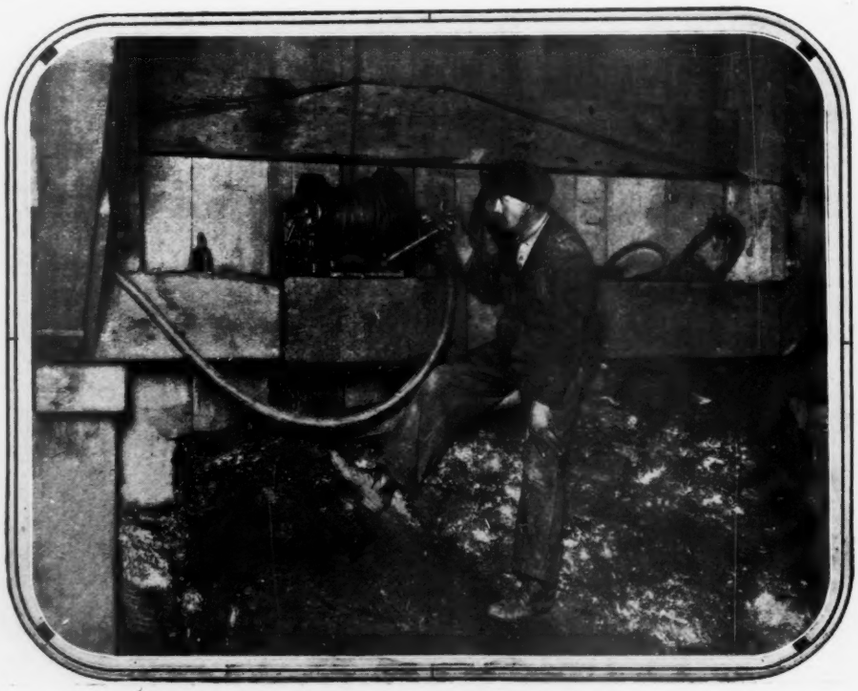
Cameron pumps, driven with compressed air, have been placed at strategic points to drain the cut.

The ramps, of which there were 12 placed at suitable intervals along the center line of the 8,600-foot section, were built so that their portals would be in the middle of the street. Each ramp had a slope of 14 degrees, was 15 feet wide, and the longest of them had a length of 150 feet. Loaded motor trucks had no trouble in mounting the grade. At the height of operations there were 70 trucks in service, and they moved 1,200 loads during two 10-hour shifts. The average load was 3 cubic yards. Direct, underground loading has a number of advantages; and there is ample evidence that the system employed by the Patrick McGovern, Incorporated, materially speeded up the disposal of muck.

Most of the mucking underground has been done by eight 20-B Bucyrus steam shovels modified to operate with compressed air. That is to say, the boiler usually supplied with the type was omitted and an air receiver provided instead. Furthermore, to facilitate work underground, part of the rear housing was cut away and ballast added as a counterweight. The Bucyrus shovels are equipped for caterpillar traction; and each shovel or bucket has a capacity of ¾ yard. Air has been delivered to the shovels working underground by 2-inch hose tapping the main air line running from end to end of the contract.

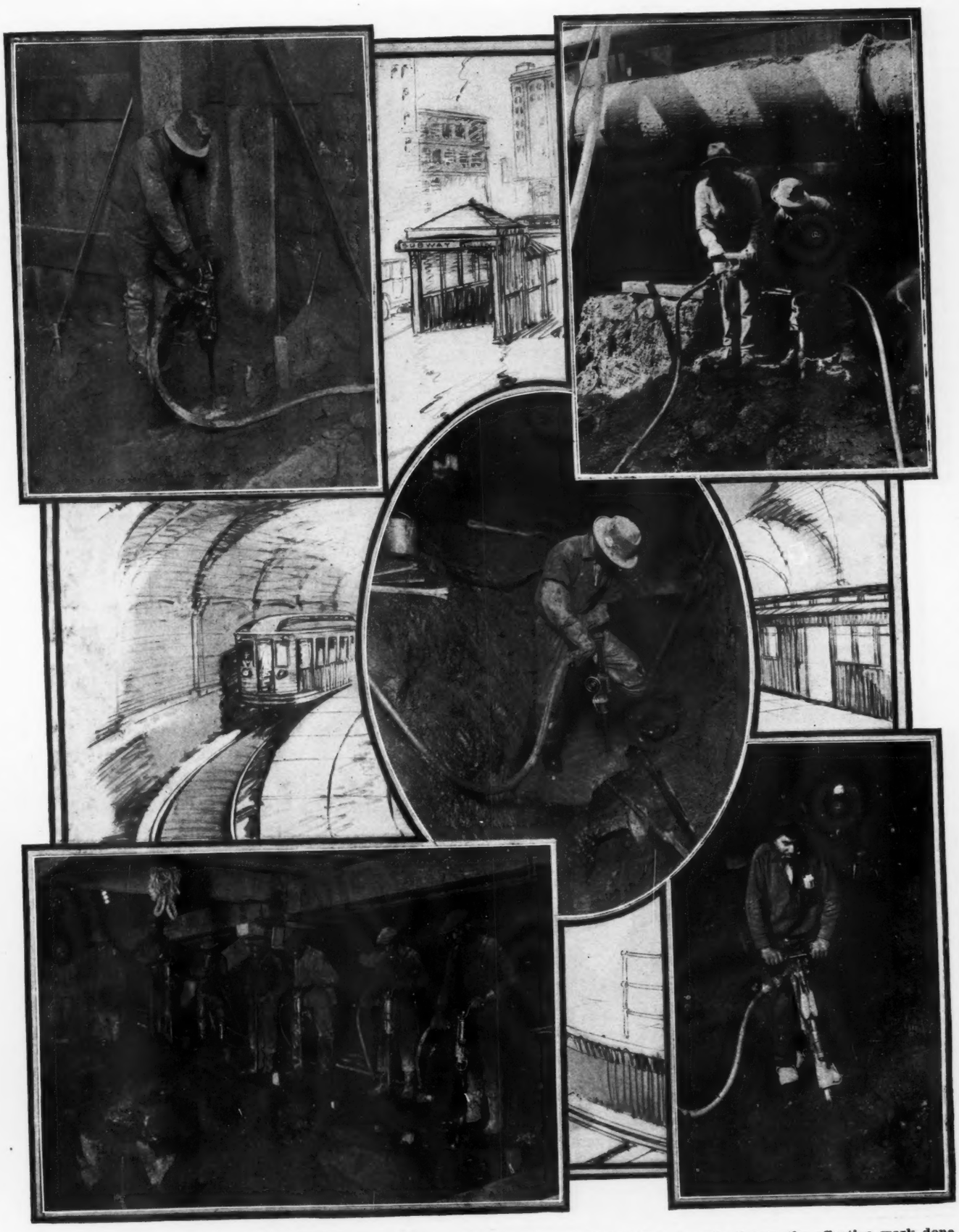
In getting out the rock—consisting of both soft mica schist and hard bluestone—no uniform system of drilling and blasting was employed: the holes were sometimes on the bench and sometimes driven as lifters—the object being to break the rock so that it could be handled by the air shovels. As a matter of fact, the rock drills, paving breakers, and even the clay diggers attacked the rock so successfully that the shovel operators had all they could do to keep their buckets close to the benches. In a few places hand mucking was resorted to, but this was abandoned as soon as the air-driven Bucyrus shovels could take over the work. All drilling was done with the BBRA-13 "Jackhamers"; but the paving breakers proved very effective in attacking some of the mica schist, while the clay diggers were extensively utilized in trimming the softer or much decomposed mica schist. The hardness of the bluestone, which formed 30 per cent. of the rock removed, can be realized when it is recalled that from 8 to 9 steels were required in drilling a 12-foot hole. The "Jackhamers" were fully equal to every task imposed upon them.

The procedure followed in digging the subway has consisted of first clearing away the asphalt and concrete surface of the street with pneumatic paving breakers, and then of removing the underlying earth to an initial depth of from 6 to 9 feet by means of power shovels. For this work, 8 combination gasoline machines were employed—each machine being able to serve as a crane or a shovel with a bucket capacity of ¾ cubic yard. Six of the shovels were of Northwest make and two of them of the well-known Pawling & Harnischfeger type. The cranes or shovels used in open-cut work were equipped with high-lift booms; while the machines operating underground were fitted with short booms that enabled the shovels to do their work satisfactorily beneath bracing having a height of only 13 feet above the floor of the excavation.



"Little Tugger" hoists have lightened the work of shifting and lifting the heavy timbers used in supporting the street decking while pushing forward the excavating.

Immediately after the initial open cut was dug, the steel I-beams were



Exceptionally rapid progress in digging the Broad Street Subway in Philadelphia is largely due to the effective work done by "Jackhamers" and paving breakers in drilling and in removing the rock formations encountered.

put in place 11 feet apart on centers, and upon these girders were placed 6x12-inch stringers which carried the 5-inch planking laid across the line of traffic. The average succeeding cut made under cover had a depth of about 10 feet, but this varied somewhat according to the ultimate depth of the excavation. Generally, the subway floor runs 25 feet below the street level, but the cut has been carried to a depth of 46 feet where the subway underruns the tracks of the Reading Railroad. Especial care had to be taken when digging beneath the railroad so as not to interfere with the movement of trains on that branch of the system. The problem, of course, was to underpin the tracks and the flanking bridge abutments and to transfer the load to the permanent steelwork of the subway. The incidental operations were carried out expeditiously and without a hitch.

Blacksmith shop where all steels used on the McGovern contracts are made fit for their work. The shop is equipped with an oil furnace, a "Leyner" sharpener, and a pedestal grinder.

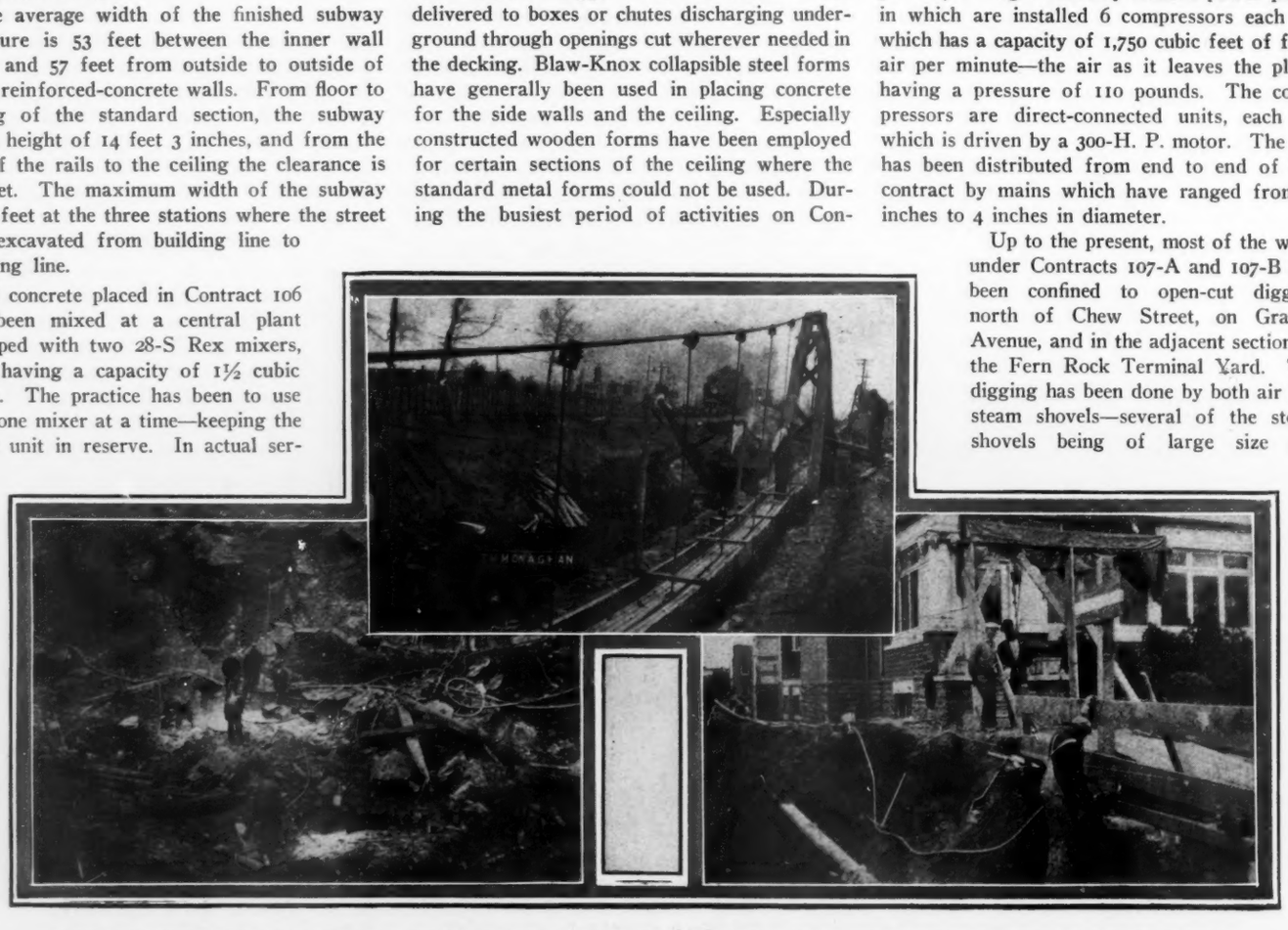
The average width of the finished subway structure is 53 feet between the inner wall faces and 57 feet from outside to outside of these reinforced-concrete walls. From floor to ceiling of the standard section, the subway has a height of 14 feet 3 inches, and from the top of the rails to the ceiling the clearance is 13 feet. The maximum width of the subway is 86 feet at the three stations where the street was excavated from building line to building line.

All concrete placed in Contract 106 has been mixed at a central plant equipped with two 28-S Rex mixers, each having a capacity of 1½ cubic yards. The practice has been to use only one mixer at a time—keeping the other unit in reserve. In actual service, the plant turned out between 30 and 40 yards of concrete an hour, depending upon requirements. The concrete has been delivered where needed by five 5-ton Mack motor trucks, each of which carried a 3-yard Easton roll-over bucket or hopper. The concrete has been delivered to boxes or chutes discharging underground through openings cut wherever needed in the decking. Blaw-Knox collapsible steel forms have generally been used in placing concrete for the side walls and the ceiling. Especially constructed wooden forms have been employed for certain sections of the ceiling where the standard metal forms could not be used. During the busiest period of activities on Contract 106, a force of 1,800 men was engaged on the job, working in two 10-hour shifts daily.

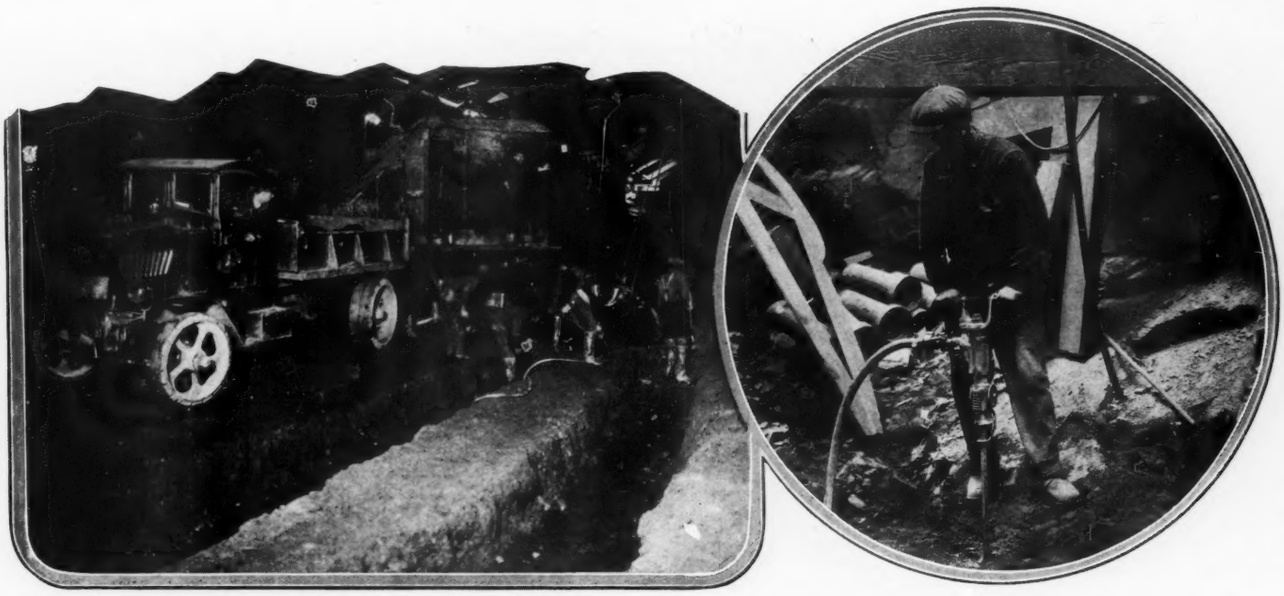
The excavation and the completed portions of the subway section covered by Contract 106 have been kept suitably drained by leading incoming water to convenient sumps from which the water has been lifted to the street surface by 16 air-operated Cameron steam pumps. All steels for "Jackhammers" and paving breakers have been sharpened and shanked by either a No. 5 or a No. 50 "Leyner" sharpener with which the blacksmith shop is equipped. In the course of four hours, during a single busy day, a blacksmith and a helper resharpened as many as 335 steels—the steels ranging from 2 feet to 22 feet in length. The blacksmith shop has a No. 25 I-R oil furnace and a No. 8 pedestal grinder.

Operating air for all purposes has been supplied by a single centrally located power plant in which are installed 6 compressors each of which has a capacity of 1,750 cubic feet of free air per minute—the air as it leaves the plant having a pressure of 110 pounds. The compressors are direct-connected units, each of which is driven by a 300-H. P. motor. The air has been distributed from end to end of the contract by mains which have ranged from 8 inches to 4 inches in diameter.

Up to the present, most of the work under Contracts 107-A and 107-B has been confined to open-cut digging north of Chew Street, on Grange Avenue, and in the adjacent section of the Fern Rock Terminal Yard. The digging has been done by both air and steam shovels—several of the steam shovels being of large size and



Snapshots of the work now being pushed forward at the north end of the subway and in the Fern Rock Terminal Yard.



Left—Here are seen paving breakers at work excavating soft schist, while an air-operated shovel loads the excavated material into a waiting motor truck.
Right—One of the numerous BBRA-13 "Jackhamers" drilling in a comparatively hard mica schist formation.

equipped with high booms so that they could handle the excavated material and discharge it into trucks standing at the street level. The excavation will be carried to a maximum depth of 55 feet in this northernmost section of the Broad Street Subway, and approximately one-third of the digging will be open-cut work. Throughout the decked over portions of Contracts 107-A and 107-B, the standardized practice employed so successfully in Contract 106 will be followed. Compressed air will be furnished by the plant already described, and the air will be distributed through a main ranging from 10 inches down to 6 inches in diameter. All told, this main will have a length of about 12,000 feet.

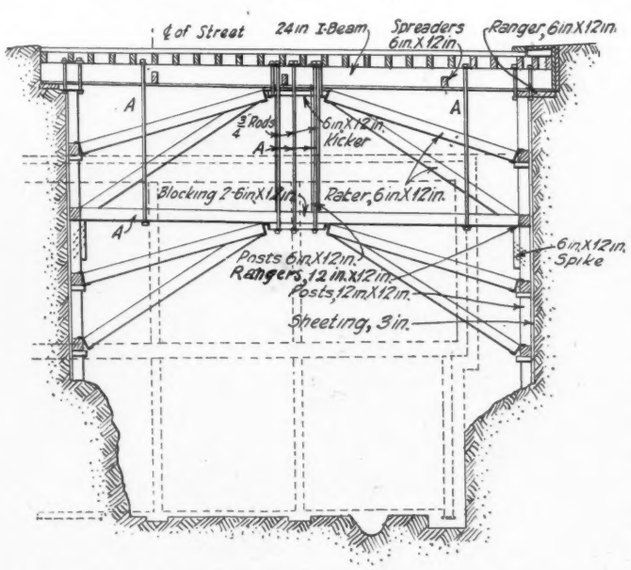
The executives of Patrick McGovern, Incorporated, are confident that they can maintain on the new work the same splendid rate of progress attained on Contract 106. Mr. McGovern keeps in close touch with the job in hand, as has been his way for years, and he can be seen well-nigh daily somewhere along the line and especially wherever the task is proving at all difficult. His presence is an inspiration to the able men associated with him. The vice-president of the company is E. D. Hubbard; J. S. McDonald is chief engineer; Charles Kelly is master mechanic; and Patrick Porter is general superintendent.

"Greater prosperity through greater foreign trade." This was the slogan that recently dominated the annual meeting in Seattle of the National Holland Trade Council. There was manifest throughout all the conferences and the formal addresses a spirit of determination, of vigorous progressiveness, and of confidence in the future of American merchandise abroad.

DEEPEST OIL WELL BREAKS MANY RECORDS

THE Miley Oil Company's No. 6 Well, at Athens, Calif., is the deepest well of its kind ever drilled—having reached a final depth of 7,591 feet, or an equivalent of nearly a mile and a half. Besides breaking the record for depth, many other records were made in drilling the well.

According to Mr. Wendell M. Smith, in *Oil Bulletin*, the outstanding facts are: largest string of drill pipe; largest string of casing; deepest perforated casing; deepest cement job; deepest core extracted; deepest oil sand; greatest drilling speed; and lowest cost per foot of well drilled. The total cost of the job was $170,000; and the well is producing about 1,500 barrels a day.



Standardized method employed by Patrick McGovern, Incorporated, in supporting the decking and in bracing the sheeting used to prevent inward movement of the walls of the excavation.

BRAVE MINER CONQUERS MISFORTUNE

FIFTEEN years ago, so we are told in *Coal Age*, Reuben Williams was just an ordinary coal miner employed in a mine in West Virginia. As the seams were thin, Williams had to do his work in a very uncomfortable position. He was therefore compelled to give up coal mining, and in due course became a laborer on a railroad. While so employed, a landslide caught Williams and pinned him between two boulders; and, to free him, it was necessary to cut off both his legs above the knee.

He might have become a beggar; but not Williams. Instead, he is again a coal miner—his shortened stature, 42 inches, enabling him to work beneath the low roofs in a nearly upright position. Williams averages daily 14 tons of coal, drilled, blasted, and loaded. Only grim determination and persistent struggling against well-nigh insuperable odds could have made this man come out on top. As it is, he enjoys the comforts of a good home that he is providing for his wife and boy; and he has won the respect of everyone with whom he has come in contact.

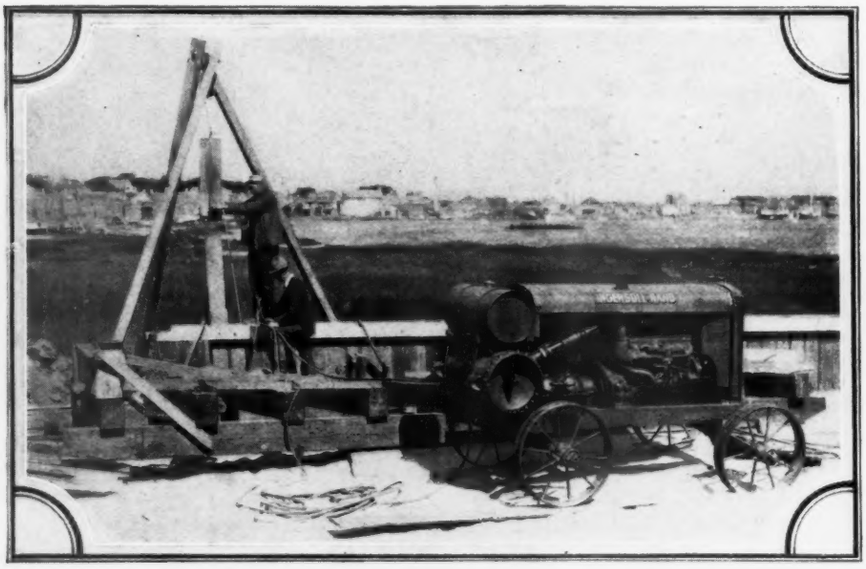
The linking of four South American countries by railways of the same gage was achieved last year with the opening of the line from Atocha to Villazon, Bolivia, a stretch of 124 miles. At Villazon the road connects with the Argentine railway system, and at Atocha it joins the system operated by the Antofagasta & Bolivia Railway Company, thus offering a connection with Antofagasta and with the principal cities of Peru.

Driving Sheet Piling by Compressed Air

By R. T. JACKSON

IN THIS high-pressure age, any device that will shorten the time required to complete a particular job—even if the saving be but a moderate one—should be welcome. Now comes a new method of driving piling, in which compressed air plays the *rôle* of time saver.

At the South Beach Boat Yard, on the Island of Nantucket, where a bulkhead was recently under construction, the piling was driven or, rather, set up by the use of compressed air. As a result of the procedure followed, the work was done much faster and better than it could have been done by the familiar method of hammering.



A wooden block with an iron shoe, suspended from a pulley, served as a hammer in driving the sheet piling into the loosened sand.

The piling material of 3x8-inch, double-grooved, North Carolina hard-pine flooring, came in 20-foot lengths. This material was cut crosswise at an angle, thus making each pile as used slightly over 10 feet long. The purpose of the angle-cut was to give one end of the pile—the bottom end—a point. In driving, the pointed end was set next to the bulk of the work so as to give the bulkhead a firm hold in the sand. The top and bottom stringers are of 4x6-inch spruce.

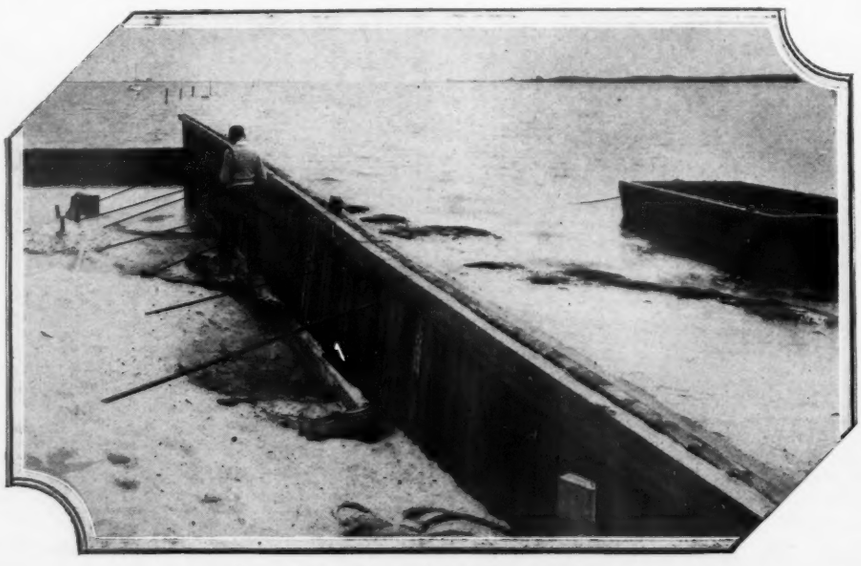
In constructing the bulkhead, two stringers were laid parallel on the ground, 3 inches apart, and firmly fastened together. Two more stringers were then similarly secured at a suitable height above the bottom stringers. These served as a slot, in which the piles were inserted. The groove in each edge of a pile measured 1x1 inch—thus making a hole between adjoining piles of 1x2 inches. Into each one of these holes a spline was set at the time the planks were placed for driving. A tripod, constructed of 4x6-inch stringers and with a pulley block hanging from the peak from which to suspend the driving weight, was next set up. All was now in readiness for the actual driving of the piles.

The compressed-air device employed for this work consisted of a 6-foot length of ¾-inch galvanized pipe having a ⅜-inch air connection at the top and a ½-inch water connection set horizontally immediately below the air connection. The water, which was piped from the city main, had a pressure of about 40 pounds, while air at a pressure of 90 pounds was used. When stuck into the sand and put in operation, this driving device rapidly cleared a hole, having a cross-section area of about 2 square feet, into which the piles were successively sunk by lightly tapping them with the overhead wooden block. This block, together with the attached iron shoe, weighed about 125 pounds; and it was raised by means of a steam-driven winch placed near by. The tripod could be moved easily and set in place by two men.

The action of the air and water was such as to wash the heavier gravel and stones out of the hole or to wash out the sand while letting the heavier material fall to the bottom of the hole. In either case, any obstructing stones were effectually removed from the direct downward path of the pile. This method has been found to work as well in dry as in wet sand, as the water and the air pressure keep the mass in the vicinity of the pile in such a condition that it can be penetrated readily. Usually, a sufficient length of top and bottom stringers was laid so as to allow the placing at one time of about 28 piles, together with the necessary number of splines. These were then driven rapidly to a depth of 4 feet beneath the surface of the sand.

After the driving of a set was completed, each pair of stringers was firmly secured by a ½-inch bolt placed as close as possible to the last pile sunk—air-driven drills being used to bore the bolt holes. Wedges were then driven between these bolts and the piling for the purpose of forcing the whole set firmly together and of making it watertight. After that, ½-inch holes were bored at suitable intervals by the air drill, and into these holes were driven bolts, 12 inches long, to tie the structure permanently together. The bulkhead is kept from bulging outward by a series of 12-foot iron rods, 1 inch thick, which penetrate the structure and which were run back and attached to a log or "dead man" buried in the beach.

As it was found necessary to remove a section of the beach in front of the bulkhead, this sand was used for backfilling.



How the bulkhead looked when finished.

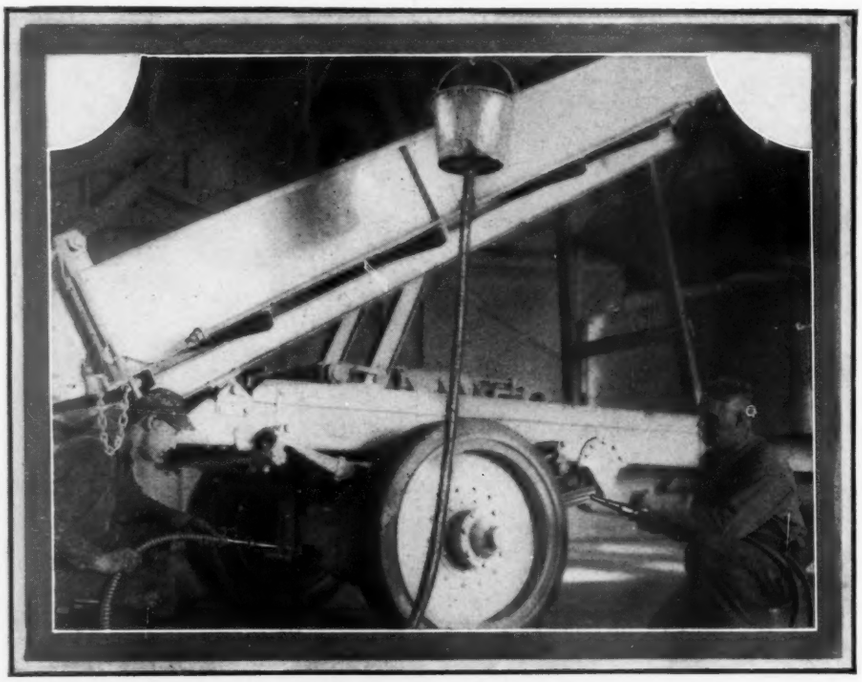
Fig. 1—Portable compressor that furnished the air for the pile-sinking work.
Fig. 2—Workman using pipe excavator through which water and compressed air are forced downward into the sand. The net effect is to agitate and to loosen the compacted sand so that the sheet piling can be hammered easily into place.
Fig. 3—Air-driven drill boring half-inch holes during the construction of the bulkhead.
Fig. 4—Part of property of the South Beach Boat Yard where the bulkhead was built.
Fig. 5—Near view of shore front which is now protected by the bulkhead shown partly completed in this picture.

It was hauled to the desired place by a drag scoop operated by a steam winch—the outer end of the rig being attached to an anchored raft. The tide at that point has a rise and fall of 3 feet; and, before the beach front was cut down, the water within the bulkhead at high tide was 2 feet lower than that outside. In other words, before the water was prevented from getting back of the bulkhead, holes had to be bored in the structure to allow the water to escape when the tide receded. About 330 feet of bulkhead had to be constructed. Six men were employed on the job: 3 to cut and to carry the timber and 3 to set the stringers and to drive the piling.

By the use of the familiar pile driver, whereby main force is relied upon to pound the piles down into position, a large percentage of the piles are split and shattered and, not infrequently, have to be replaced. By the method employed at the South Beach Boat Yard, not a single pile was split. In the beginning, some of the tops were slightly roughened; but this was due to the fact that those particular piles were driven with the wooden block minus the iron shoe. The wear and tear on the wood surface caused a slight depression to be formed in the center of the block, thus damaging the piles as mentioned. However, with the addition of the iron shoe, the tops were no longer roughened.

By the use of compressed air it was possible to do the work of driving in less than half the time in which it could have been done by a pile driver. In short, the average time required to sink a pile in the new way was 10 minutes, although 2 or 3 were usually driven simultaneously in that interval. The compressed air needed for the work was furnished by a 5x5-inch portable.

Mr. B. Dunham, who did the actual driving, stated that the air-and-water method of pile sinking beats all other methods that he has ever employed or seen used on kindred work. And as Mr. Dunham has had a hand in putting down nearly all the piling that has been driven in recent years on the Island of Nantucket, this statement is significant. Mr. H. V. Chase, superintendent of the South Beach Boat Yard, expressed himself in much the same fashion.



In the up-to-date shop of the California Highway Commission the state-owned automobile trucks are cleaned and painted by means of compressed air.

The Legation of Switzerland, at Washington, has announced that an international exhibition of inland navigation and the utilization of hydro-electric power will be held at Basel, Switzerland, from July 1 to September 15, 1926.

Filling the gravity-feed bucket with paint preparatory to hoisting it to the ceiling. Workman at the left is holding one of the paint-spray guns.

A perfect reflector of light for general service does not exist. Glass, backed with a silver coating, is generally used for this purpose; but, besides being fragile and costly, glass has well-known optical defects. The metallic reflectors hitherto employed have been not only unsatisfactory in polish and in reflective power but difficult to maintain in good condition. Dr. Robert J. Piersal, research physicist of the Westinghouse Company, has described, in a recent paper, a reflector with a surface of polished chromium. This metal is much harder than steel, takes the highest polish known, and does not tarnish or corrode through exposure.

COMPRESSED AIR CLEANS AND PAINTS TRUCKS

AT THE main shops of the California Highway Commission the painting of trucks by compressed air has reduced the cost of this work, as against hand painting, by more than 50 per cent. Formerly it required two men one day to paint a truck by hand brush, but by the air-spray system one man can now paint a truck in one day and do a much better and more satisfactory job.

To facilitate operations, the supply of paint is poured into a bucket which is suspended from the shop ceiling and raised and lowered by the aid of a pulley. Attached to the bottom of the bucket is a hose through which the paint is fed by gravity to the paint spray. When ready to begin work, the bucket is raised to the desired position—thus permitting a steady flow of paint to reach the spray nozzle. But before a truck is painted it must first be cleaned; and for this purpose compressed air is also used. By means of a stream of air, discharged from a blow gun, the dust and dirt are quickly removed and the car made ready for its new coat of paint.

Transvaal Probably World's Richest Platinum Field

More Than Two Thousand Square Miles of Platinum-Bearing Ground Has Been Found in South Africa

By OWEN LETCHER*

SOUTH AFRICA is, it appears, winning fresh laurels as a jeweler's store house. For many years past it has been the greatest gold and diamond producing region in the world; and now it is to have the added distinction of supplying us with platinum.

Unquestionably, in the near future, the Transvaal will become the world's leading source of platinum. Discoveries made during the past two years in various localities of this, the richest province of the Union, have already established the existence, first, of rich but erratic platiniferous deposits existing in brecciated felsites over a belt, about 30 to 40 miles long, in the Waterberg District; second, of a platinum rand, nearly 80 miles long and containing two distinct geological horizons, in the Lydenburg District; and, third, of platiniferous deposits, chiefly in the norite zone, in outlying areas such as Pietpotgietersrust, Carolina, and Barberton.

Gold, diamonds, and platinum—three things that delight the hearts of the fair sex—are the main stock in trade of the jeweler. Some one has facetiously remarked that the next thing we shall probably stumble across will be diamonds in platinum settings lying in the ground just as they appear in Tiffany's window. This is, of course, a phantasy, but it is a fact that in some portions of the Lydenburg District there is found in the crude country road norite giving about 4 pennyweights of platinum to the ton. And with platinum at $125 an ounce, the mineral wealth contained in the limited amount of developmental work done to date on the Transvaal Consolidated Land & Exploration Company's farm *Onverwacht* represents a gross value equivalent to that of the annual output of a fair-sized Witwatersrand gold mine.

The discovery of these platiniferous deposits has, of course, resulted in a great deal of speculation. Shares have gone up to ten and twelve times their normal value, and there have been tremendous fluctuations in price. But quite apart from this phase of the platinum "boomlet" of 1925 in South Africa, there is the more permanent and enduring aspect of the matter—that is, the unquestioned fact that platinum has been found in the Transvaal, and that the industry of mining and winning this precious mineral has come to stay. The platinum industry is already affording employment to about 200 Europeans and 2,000 natives; many thousands of pounds sterling have been expended on options and in the buying of farms; and much money is being spent in purchasing mining machinery and supplies, prospectors' equipment and explosives, as well as on transportation, etc.

Within the next few months the first tangible fruits of all the exploratory work that has been carried out there will begin to make themselves felt in the shape of production. A plant of 1,000 tons per month capacity is nearing completion on the Transvaal Platinum Company's property in the Waterberg District. Production from the alluvial and the detrital matter in the Steelpoort Valley has commenced; and it is reported that a small crushing and concentrating plant is to be erected in the near future at *Onverwacht*. These initial producers will, of course, get the full benefit of the high price of the metal, and they will doubtless embark on a policy of selective mining and draw on their richest ore deposits.

BECAUSE of its comparative scarcity, platinum has been the most costly of the precious metals used in latter years by the jeweler. The sources of supply have been limited, and the prospector has, therefore, searched far and wide in an effort to open up new and more productive deposits. These efforts have recently been crowned with success.

In South Africa, platiniferous deposits have been discovered which bid fair to make that part of the world the greatest of known platinum fields; and it is our privilege to tell something about these deposits and the painstaking work that has determined their richness and their extent.

The beginning of productive operations synchronizes with the beginning of relatively deep mining operations, and this implies an increasing demand for mining machinery of all kinds. The machinery merchants of Johannesburg are watching the situation closely; and their representatives, through actual inspection, are making themselves thoroughly conversant with the peculiar conditions of the various prospects and the needs of the companies. Although no very large individual orders have been placed up to the present, there is being done a fairly substantial business. The proportions of this business will steadily increase as mining operations are carried down to a greater depth and as demands arise for rock-drilling machinery, small hoists, sinking pumps, etc. It is interesting to note that the Transvaal Estates & Development Company is already contemplating the installation of an Ingersoll-Rand producer-gas-driven compressor, together with drills, so as to expedite the development of their properties in the Lydenburg District. But before going into further details, it might be worth while to give the readers of this Magazine a general outline of the history of the discoveries and a brief description of the outstanding geological features of the fields.

About the middle of 1923, Mr. "Dolph" Erasmus, a well-known Transvaal prospector, was panning for gold at the eastern end of the farm *Welgevonden*, No. 1771, which is situated 12 miles from the progressive little Township of Naboomspruit, on the Pretoria-Pietersburg Railway. Years previously, in washing dirt from the felsite ridges on this farm, Erasmus had found specks of gold in the pan. The gold discoveries in the western part of the Rustenburg District recalled this incident to his mind, so "Dolph" betook himself again to *Welgevonden* which, in point of fact, had been proclaimed a public goldfield as long ago as 1893. One day, thirty years later, while panning some loose ground from an ant heap, Erasmus observed in well-nigh his first panning not only a few specks of gold but a heavy tail of grayish-white concentrate that lagged behind the gold in the pan. Arguing that this tail must be heavier than gold he at once jumped to the conclusion that it was platinum, as that was the only metal he had heard of that was heavier than gold. He telephoned his discovery to Mr. Baumann, manager of the Rooiberg tin mine, located in the district, who had for some time been supporting Erasmus financially. Baumann was at first incredulous; but at once recognized the soundness of Erasmus' argument when it was advanced. He therefore visited the ground; and he and Erasmus had no difficulty in proving that the metal had its source in a prominent and well-known quartz lode lying a little to the southeast of the point of the original find.

Mr. Baumann now resolved to raise money among his friends in order to secure as much as possible of the ground in question. This he had no difficulty in doing. With these funds was floated a small company, the Transvaal Platinum, Ltd., and it is this company which is now concerned with the exploitation of the platiniferous ore body found by Mr. Erasmus. This is the pioneer platinum concern of the

*Editor, *The Mining and Industrial Magazine of Southern Africa.*

subcontinent; and, as it is now approaching the outputting stage, the company will thus also become the pioneer producer.

The Transvaal Platinum, Ltd., has at present a capital of £30,000 in 120,000 shares of 5 shillings each. The company has been able to keep its issue down to such a low level and at the same time to attain its present satisfactory position by sound and conservative financing, by the issue of shares at a high premium, and by good management. Furthermore, the intimate association of two powerful companies like the Transvaal Consolidated Land & Exploration Company and the South African Townships—which companies previously owned the properties acquired and have sponsored the mine in regard to its capital requirements—has also conspired towards placing the Transvaal Platinum, Ltd., in the successful position in which it now finds itself. The properties consist of the farms *Welgevonden* and *Reitfontein;* and on them a main and a branch lode sector are being exploited. The lode is best described as a quartz-impregnated fault zone. It ranges in width from 6 feet to 28 feet, its walls being, as a rule, very poorly defined. The strike is from northeast to southwest, and the dip from 65 to 75 degrees to the southeast.

Values in this mine fluctuate enormously over small sections; and in development, in order to keep a close check on the platiniferous content, two samples are taken for each 2 feet, while approximately 1,400 assays are made per month in the well-equipped little laboratory and assay office on the property. At some points, phenomenally rich values have been determined; and assays have been obtained going as high as 3,000 pennyweights to the ton.

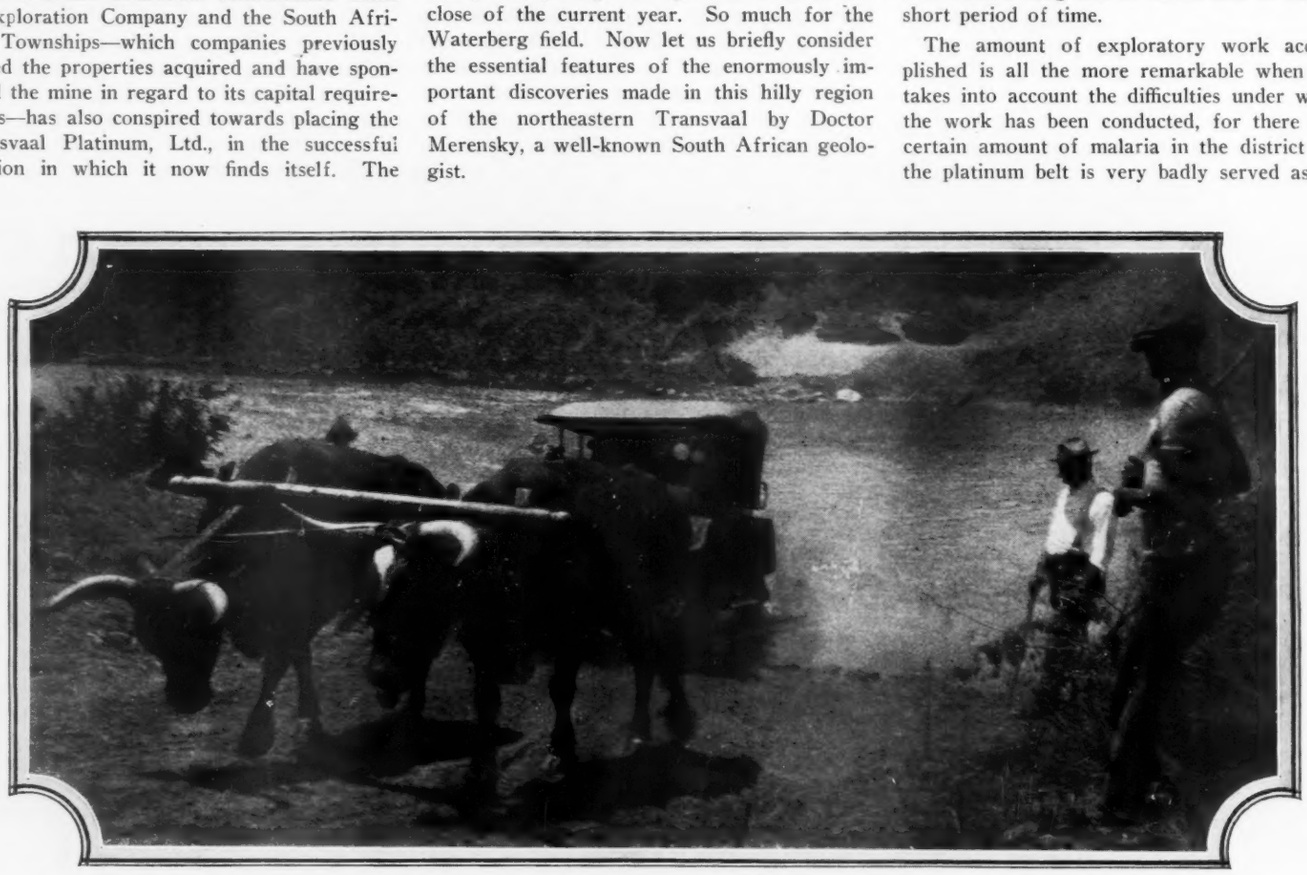
For some time past, experiments have been in progress at the Leeuwpoort tin mine and in the "Corner House" laboratories with a view to determining the most effective and economical process for the treatment of the ores. It it understood that these tests have disclosed that a simple crushing and concentrating plant, embodying classifiers and Wilfley and "Sennpan" tables, is able to extract 60 per cent. of the precious content of the ore. Supplementary to this, a chlorination process will be employed, so it is understood; and a total extraction of about 92 per cent. is expected. This new plant will probably be put in operation towards the close of the current year. So much for the Waterberg field. Now let us briefly consider the essential features of the enormously important discoveries made in this hilly region of the northeastern Transvaal by Doctor Merensky, a well-known South African geologist.

The first of the sensational finds of platinum in hortonolite, dunite, and norite, were made about the middle of 1924; but the secret was so well preserved that it was not until October of the same year that information leaked out with regard to the discoveries made by prospectors working for the Lydenburg Platinum Syndicate and the Transvaal Consolidated Land & Exploration Company. Since then there have been sensational developments—culminating in the remarkable scenes witnessed on the Johannesburg Stock Exchange in March. Many new concerns have come into the picture; and land-owning companies of long standing, such as the Transvaal Estates & Development, the South African Townships, Henderson's Transvaal Estates, and the South African Land & Exploration Company, have found that they possess extensive areas on the belt.

Sufficient work has already been done to demonstrate the existence of a platinum belt, containing at least two main payable horizons, extending from a point some little distance north of Dullstroom, on the Belfast-Lydenburg Railway, to as far north as the Olifants River. According to the latest information available, the formation swings off to the southwest in the extreme southern portion of this area and has been located in the Middleburg area. It is questionable whether the existence of precious-metal deposits has ever been determined anywhere else in the world over such a long line of strike and in such a short period of time.

The amount of exploratory work accomplished is all the more remarkable when one takes into account the difficulties under which the work has been conducted, for there is a certain amount of malaria in the district and the platinum belt is very badly served as far as roads are concerned. The most spectacular development of all has been that attending the exploitation of the dunite *kopje* on *Onverwacht.* This property is under the control of the Central Mining-Rand Mines group, generally known as the Corner House, which is the most powerful corporation operating in South Africa. On this property a prospecting shaft has been sunk into the platinum-bearing dunite to a depth of 100 feet. The average value was no less than 24.2 pennyweights of platinoids or, say, $150 per ton of ore! But while the dunite may be the most spectacular of the two horizons from the point of view of pennyweights or of ounces to the ton, it is in what geologists term the "pyroxenite-diallage-norite" zone that most of the hope is reposed for the establishment of an enduring platinum industry.

The pyroxene-rich, mottled, sulphuric norite occurring on this horizon outcrops continu-



Plodding oxen pulling a stalled car out of a shallow stream. One of many transport difficulties encountered in the Lydenburg platinum field.

ously for thousands of yards and carries from a fraction of a pennyweight to 7.5 pennyweights of platinum over widths ranging from 2 to 8 feet. Values over considerable stretches have been proved to be fairly consistent, averaging from 2 to 3 pennyweights, but it is already clear that some stretches are richer than others. Careful sampling will doubtless disclose the existence of rich and poor patches; and, by reason of the low average platinum content of the rock, the accurate determination of such patches will be of the utmost importance.

Even more important, however, is the question of the extent to which the platinum content of the outcrop rock has been affected by secondary enrichment. Heavy metals, like gold and platinum, are extraordinarily susceptible to surface concentration, and the outcrops of deposits containing these metals have sometimes been enriched in the most unaccountable manner.

The fact that the platiniferous norite carries much the same values whether it is exposed on the crest or on the slopes of the ridges, in stream beds where there has been active denudation, or in isolated boulders lying on the surface, appears to indicate that there has been no marked enrichment, and the low dip of the sheet also seems to preclude this. The only way to settle the question, however, will be to sink a number of shafts to a depth below the possible influence of mechanical surface enrichment and to sample the rock systematically at this depth. Until this is done, it will not be possible to express a definite opinion on the value of the whole of the main horizon as a potential source of platinum.

It is quite possible that there will be changes in the platinum content of the norite at water level, which will probably be found to lie at an average depth of 70 feet below the surface. With a dip of 11 degrees, this would mean a distance, measured along the incline, of over 360 feet before the water level is reached. What has happened below water level is thus at present of little moment.

The success which attended prospecting operations in the Lydenburg norite belt very naturally directed attention to the development of the norite and the associated basic rocks in the Rustenburg District. The geological character of these rocks, petrographically and structurally, is similar in each area. So far, however, inquiry has been mainly directed to the chromite occurrences along the belt. Experience in the Lydenburg District has shown that the best platinum values are found outside the chromite bodies; and assays of this ore from Waterval and Arnoldstadt, adjoining the town lands of Rustenburg, have shown results up to 4 pennyweights or more. They are sufficiently good to warrant further investigation.

Native miner at work on platiniferous brecciated felsite found in Waterberg District.

At De Kroon, just north of the Haartebeestpoort Dam, high values are said to be consistently carried in the chromite seams. A body of hortonolite-dunite is said to have been discovered along that line, a circumstance that emphasizes the resemblance to the Lydenburg norite zone. The district has the advantage of a railway line which runs through the belt from Pretoria to Rustenburg, is well supplied with water, and lies at no great distance from the chief industrial centers of the Transvaal. The various discoveries made to date on that side of the Bushveld go to show that the Rustenburg area constitutes an important section of what may be termed the "metallographic province" of the great Bushveld lopolith; and the tide of prospecting activity that is already flowing in that direction from Lydenburg, via the northern Middleburg escarpments, may rise to considerable proportions.

To the northeast of Potgietersrust, there is a narrow strip of sedimentary beds belonging to the dolomite series of the Transvaal system. This appears to be a disconnected mass, for the norite is found upon both sides of it and a fringe of later red granite runs along its western edge. This particular district is now engaging a great deal of attention; and it is reported that one of the largest Rand mining houses has just recently negotiated for an interest in the acquisition of properties upon which the platiniferous norite, carrying highly payable values, has been opened up for a distance of 12 miles.

Altogether, over 2,000 square miles of the Transvaal has, during the past few months, been proved to be platiniferous. A large number of syndicates and companies—which have no other intention than to "rig" the stock market on the basis of a few more or less worthless options in a popular locality—have of course been formed. But the larger and more stable concerns, such as Transvaal Consolidated Lands, Lydenburg Platinum Areas, Platinum Proprietary & Transvaal Estates & Development, for example, are assurance that there will be an enduring platinum industry in South Africa.

No insuperable metallurgical difficulties are anticipated: the question of control of the price of platinum will, however, call for close investigation and coöperation. To this end it is urged that there should be a conference of potential producers in the near future. It is interesting to note that one or two American mining engineers of standing have recently arrived in South Africa and are engaged in an investigation of certain areas in the Lydenburg District.

A typical platiniferous dunite kopje in the Lydenburg District.

HIGHEST TEMPERATURES

THE highest temperature yet produced by man is said to have been reached at the University of Leeds, England, by the combustion of ordinary manufactured gas combined with oxygen. A temperature of 7,677° F. was reached, or 4,287°C. The temperature of the sun is more than 6,000° C.; and the source of its heat is only one of the many questions still challenging solution.

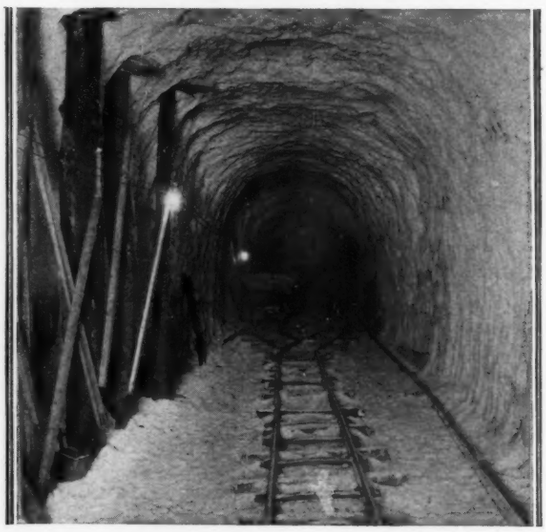
Fertilizers that are absolutely odorless and yet chemically correct are produced in large quantities, but they are generally unsaleable to the average farmer. Only those with a pronounced bad odor are acceptable, so it is said. Accordingly, manufacturers are learning to "sweeten" their fertilizers with strong-smelling solutions which have no deleterious effect one way or the other on the soil but are immensely stimulating to the trade.

Compressed Air Revolutionizes Method of Driving Tunnels Through Sandrock

By B. M. COWAN*

UNDERLYING the greater portion of Saint Paul and Minneapolis, Minn., is a very thick stratum of soft sandrock, and directly over this material is a thick layer of limestone. Due to this unusual formation it has been the practice of engineers in this district to drive tunnels through the material for such purposes as sewers, water pipes, electrical cables for power and lighting, and caves for the growing of mushrooms and the storage of certain articles of commerce requiring a constant temperature the year round.

The method hitherto employed by contractors to dig through this sandrock was, first, to bore holes about 1 inch in diameter and from 20 to 30 inches deep with an auger operated either by hand or by power, and then to explode a small quantity of dynamite in each of them. Or, more often than otherwise, tunnels were driven by men working at the headings with short miners' picks sharpened to a very fine point.



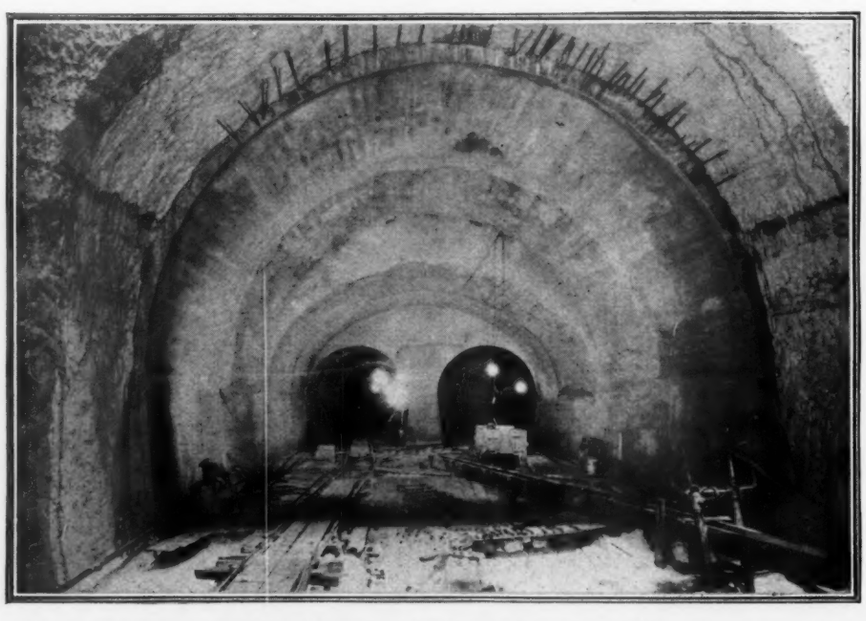
Tunnel through sandrock during early stage of driving.

During the construction for the Ford Motor Company of a group of buildings along the Mississippi River, at St. Paul, it was necessary to drive a number of tunnels through this sandrock. Some of these tunnels were horseshoe shaped and about 14 feet high and 12 feet wide at the base, while others were about 4 feet wide and 7 feet high. At the beginning, picks and augers were used; but as the progress so made was quite slow it was decided to employ some other faster means. It was soon discovered that compressed air could be utilized to good advantage; and it was promptly applied in the following manner:

A piece of ½-inch wrought-iron pipe about 5 feet long, was made up with one end nozzled to a ⅜-inch opening and the other end attached to an air hose and a valve supplied with air at about 80 pounds pressure. When all was in readiness, the operator slightly turned on the air and held the tip of the pipe against the sandrock where the hole was desired. In a few seconds the blast of air had disintegrated the sandrock to such an extent that an excellent sand-blast action was induced; and that was all that was necessary to bore a hole about 1⅛ inches in diameter. It was found that with air at 65 pounds pressure the depth limit of a hole was about 5 feet and that the time consumed in boring was approximately 2 minutes. With the auger method it usually took from 15 to 20 minutes to bore a 2½-foot hole.

In excavating the larger tunnels it was customary to drill about four 5-foot holes near the center of the heading and then to explode several sticks of 20 per cent. dynamite—thus blasting a good-sized cavity. A row of holes, on approximately 18-inch centers, was next bored around the perimeter of the tunnel face. Each of these holes was loaded with about half a stick of dynamite, and the entire group exploded simultaneously. The results were excellent, as a very neat outline was obtained and sufficient material excavated to keep five or six muckers busy for several hours.

It is believed that other contractors in this district are now using this method for driving tunnels in sandrock and are doing so at a very decided saving over the methods previously employed there.



Section of the tunnel when nearly completed.

Construction Superintendent.

AIR TOOLS FAVORED IN WELSH COAL FIELDS

THERE is a decided tendency in the Welsh coal fields to supplant steam power with electric power. This tendency will undoubtedly grow as public-service facilities are provided for furnishing electric current, which must now be generated by the companies, themselves. One of the recently organized anthracite coal combines has undertaken to install about $700,000 worth of new machinery, most of which is electrical.

Colleries are, to a large extent, using electric power on the surface for hauling and for dumping. Electricity is also employed for pumping. This is important, because in the Welsh field nearly every pit has to have a pumping plant to prevent flooding. The rating of the pumping equipment varies from 10 H.P. in a small, shallow pit to about 1,000 H.P. in the largest and deepest pits.

But the use of electrical equipment in the drifts, themselves, is not in great favor, because of the danger of explosion from chance sparks. For instances, in 1913, out of 115 coal cutters utilized in the Welsh field, 36 were driven by electricity and 79 by compressed air, while of the 361 machines in service ten years later 78 were operated by electricity and 283 by compressed air.

CALORIC TURBINE

Perhaps Hero of Alexandria was mainly a historian; but he has left to posterity ample evidence that he was not lacking in imagination and in ingenuity. This would certainly seem to be the case in his 70th Proposition, wherein he depicts and describes a calorific turbine. Not only does that Proposition reveal a knowledge of engineering quite out of keeping with mechanical developments of that age, but the whirling platform with is gyrating dancers discloses how much akin has been the spirit of youth for many, many centuries. It is hard to believe that some of Hero's fancies were not developed in his writings.

Hero's 70th Proposition shows how heat can be made to expand and to compress air confined in a metal cylinder, B, so as to force it downward into an expansion chamber, E C, and thence by way of a hollow shaft, C, to four propelling jets, D, D, D, D, suitably attached to a disk, R, supported by a pivot bearing. The escaping air was directed against the sides of a glass-walled chamber, A. In principle, the turbine was designed to function much like the reaction turbine of the present day.

Compressed Air Magazine

—*Founded* 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:

Bowling Green Building, No. 11, Broadway, New York City. Tel. Bowling Green, 8430

Publication Office: Somerville, New Jersey

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

WILLIAM LAWRENCE SAUNDERS
President

G. W. MORRISON
Treasurer and General Manager

ROBERT G. SKERRETT
Editor

FRANK RICHARDS
Associate Editor

M. V. McGOWAN
A. M. HOFFMANN
H. H. STARKEY
Assistant Editors

JOSEPH W. SHARP
Secretary

FOREIGN CORRESPONDENTS

Paris
BEN K. RALEIGH
10, *Square Desonuettes*, 19 *Boulevard Victor*

London
ROLAND H. BRIGGS
No. 165, *Queen Victoria St., E. C.* 4

Vienna
A. J. DE HULLU
3, *Afrikanergasse*

Madrid
LUIS BALDASANO Y LOPEZ
No. 7, *Jorge Juan*

Canada
F. A. McLEAN
Sherbrooke, Quebec

EDITORIALS

CAUTIONING IRRESPONSIBLE CONTRACTORS

THE depths that may be reached by those of business incompetence was forcibly exemplified a short time ago when a large bonding house experienced 1,790 defaults in general construction work. Another large company actually paid out in losses 92½ per cent. of all premiums received on road-contract bonds; and, at that, the percentage did not include taxes and administrative costs.

It is the irresponsible contractor that has brought about this condition of affairs. Perhaps an injudiciously low bid wins him a contract on some important public work; and then, through lack of funds, incomplete equipment, or inexperience, the job is fizzled.

What is the outcome of such an occurrence? First, the surety company that bonded the incompetent contractor is out of pocket. Second, the award of the work to the incompetent contractor has deprived a responsible and an experienced contractor of a job to which he was entitled. Third, the state, or the ultimate taxpayer, is made to carry the burden of the mistake—not to mention possibly numerous unsecured creditors.

To combat this evil the Joint Conference on Construction Practices, meeting in Washington, formed a committee and drew up a form of questionnaire to be filled out by the bidder on a contract at the time his estimate is submitted. The questionnaire, which is in three parts, calls upon him to answer the following queries:

"What experience have you had? What equipment have you on hand to undertake the work? What is your financial responsibility?" It will readily be seen that such information, submitted with the contractor's bid, gives the awarder of a contract essential facts by which to determine the fitness of the bidder. In short, a low bid must be balanced with high responsibility before an award is made.

It is hoped that the conference will be successful in driving home upon public officials the danger of awarding contracts that show on their face little, if any, likelihood of a reasonable profit to the contractor. Similarly, it is hoped that surety companies will realize how criminally foolish it is to bond men whose inexperience, and lack of equipment and money foretell failure. And, finally, it is hoped that contractors, themselves, will grasp that it is not only unprofitable, but, in the final analysis, that it is a dangerous gamble to accept work when they have not the resources nor the experience needed to carry out the undertakings to a successful conclusion.

AMERICAN MACHINE TOOLS IN ENGLAND

FULLY ten per cent. of the machine tools in use in England today are of American make. In some departments of industry the percentage of American-made tools is much higher. Such is the situation as very recently reported by the United States Department of Commerce.

The significance of this recognition of our tool manufacturers is probably not appreciated by Americans generally. The recognition has not been won easily, but is the outcome of a fairly long struggle against conservatism and keen competition. The manufacture of machine tools is an old and well-established branch of British industry, and the management of British plants has commonly looked with especial favor upon the home-made product. Despite this understandable preference for machine tools of domestic origin, the British user has found it to his advantage to buy machine tools from Germany, France, and Holland where these commodities can be built and sold usually at a lower price than they can be built and offered by American makers. These circumstances indicate how the trade odds have been against substantial recognition of American machine tools; and the fact that so considerable a percentage of them is now in service in British plants is the best evidence of their undeniable merit.

We are informed that during the past four years American participation in the British machine-tool trade has had to face an unprecedented depression in British engineering industries. This depression, of course, has naturally tended to restrict purchases of machine-tool equipment. Nevertheless, American participation has continued to increase. In 1922, Great Britain took from us machine tools to the value of £239,269; in 1923, her imports of the same sort from the same source had a value of £278,585; and in 1924, her imports of American machine tools reached a figure of £341,688. According to the latest statistics available—those covering the first eight months of 1925—our machine-tool makers sold to the British products to the value of £476,379.

This growth of our machine-tool business with Great Britain, while a source of satisfaction to American makers and a well-earned tribute to the excellence of those tools, should be a matter of some concern to American manufacturers at large. The point to be borne in mind is that thousands of our industries depend to a considerable degree upon machine tools to turn out commodities at a cost which will enable our producers to compete in the markets of the world on favorable terms with European products turned out by wage earners who are generally paid at a much lower rate than is the case among similar workers in the United States.

AIR-MAIL SERVICE SHOULD BE ENCOURAGED

RECENT action by the United States Post Office Department looking to a very material expansion of our air-mail service is something in which business interests of the country should take a lively concern. Rapid means of communication have been of inestimable value in promoting business and industry, even apart from what these means of communication have meant in our social life. Accordingly, any agency that will hasten the transporting of the mails over considerable distances should be welcomed by the people at large.

There has been a disposition in some directions to criticize our air-mail service, and to base this criticism on infrequent accidents which have disrupted to only a very slight degree schedules which have been maintained with amazing regularity under all sorts of weather conditions. This Magazine has on numerous occasions made use of the service to save time that was precious. Indeed, it would have been impossible to do what was done if the air-mail service had not been available. The records made by the United States Air Mail Service should stimulate pride and not disparaging comment.

STILL GREATER NEED FOR REFORESTING

JUST once so often we are forcefully reminded by competent experts that steps must be taken to replenish our rapidly diminishing stands of timber. Despite many substitutes for wood in various fields of usefulness, still our annual consumption of lumber in one form or another is steadily increasing with each passing year. Not only that, but an enormous amount of timber is now used every twelvemonth in the production of wood pulp from which paper of various kinds is manufactured for a multiplicity of purposes. The paper-pulp industry has made great in-

roads upon our forests, and these inroads will probably expand rather than decrease in the future.

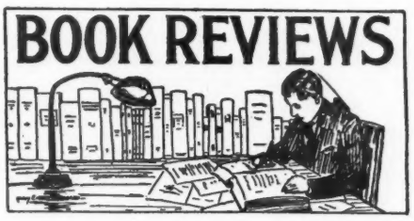
The foregoing situation is ample warrant itself for a widespread adoption of suitable systems of reforesting that will reclothe the denuded areas with marketable timber within the shortest practicable period. The need for this action has been recently intensified by the amazing expansion of the artificial silk or rayon industry. The best of this wonder product of the chemist is made from spruce, and spruce, let it be said, is a superior wood that is utilized extensively and that is rapidly disappearing from our native forests. But rayon and paper are not the only creations of the chemist that levy a heavy toll upon our stands of timber. Now comes still another product of the man of the laboratory that calls for wood and that may even outstrip rayon in volume of output and in range of usefulness. This is a material known as "Sniafil"—a cellulose product made from wood pulp and said to possess all the textile properties of natural wool.

This artificial wool can be made to sell, so we are told, at a price ranging between 65 and 70 cents a pound; and the production of this unique fiber has now reached a commercial scale in Italy. It is claimed that "Sniafil" can be handled more economically in the textile plant than wool because it does not have to be scoured and is, therefore, not subjected to the shrinkage loss which is experienced in the preparation of wool in the manufacture of cloth. Should this synthetic commodity prove to be a reasonable substitute for the wool of the sheep—which is not improbable in view of what has been done in developing rayon, then our forests will be subjected to still further inroads, and we shall have one more reason for heeding the conservationists and for systematically replanting our erstwhile timberlands.

FRANKLIN KITE TALE TRUE

SCOFFERS have had it that Benjamin Franklin would not have survived to tell the tale had he been rash enough to use a kite to tap the electrical reservoir of a stormy sky. They have said in so many plain terms that Franklin was far too wise to have risked electrocution in that manner. In short, they have proclaimed the story of that reputed experiment to be little more than a persistent bit of historical fiction.

Now we learn that there has been unearthed in a storeroom, owned by the Cincinnati Public Library, a letter written by Franklin and reciting in detail just how he had found it practicable to make the disputed experiment and how it would be possible for anyone else to duplicate his memorable and somewhat revolutionary demonstration. We owe it to the zeal of someone bent upon evaluating a dust-covered accumulation of 12,000 volumes that Franklin's letter, written probably in 1752, was brought to light. It is contained in a volume which is a compendium, so we are informed, of many letters written by Franklin and members of the Royal Scientific Society of London.



HANDBOOK OF ALASKA, by Major-General A. W. Greely, U. S. A. An illustrated volume of 330 pages. Published by Charles Scribner's Sons, New York City. Price, $3.50.

DESPITE the fact that Alaska has been part of the United States ever since 1867, still there is an astonishing lack of knowledge of that section of North America among the majority of our people. General Greely has performed a worth-while service in preparing this book, which offers a comprehensive survey of the geographical, the commercial, the social, the industrial, and the political conditions of our northernmost possession.

The book originally appeared sixteen years ago, and in its present form is virtually a new work. This rewriting has been necessary in order to bring the story of Alaska's progress up to date. Major-General Greely was twice in military command of Alaska; and he has written understandingly, sympathetically, and authoritatively about the territory. The volume should be of value to a wide circle of Americans.

NATIONAL DIRECTORY OF COMMODITY SPECIFICATIONS, prepared by the United States Bureau of Standards, and entitled Miscellaneous Publication No. 65. This book of 379 pages can be secured from the Government Printing Office, Washington, D. C. Price, $1.25.

THERE is every reason to believe that the Directory will be found of much value by every department of our industrial life. It represents the first attempt on the part of the Department of Commerce to collect and to publish a classified list of existing commodity specifications formulated not only by public purchasers throughout the United States but also by the nationally recognized trade associations, technical societies, and public utilities.

PROFITS, by William Trufant Foster and Waddill Catchings. A book of 465 pages containing numerous graphs and tables. Published by Houghton Mifflin Company, New York City. Price, $4.00.

THIS book has been prepared under the auspices of The Pollak Foundation for Economic Research, and is one of a series of kindred works written for that institution. The purpose of the volume is thus explained: "Progress toward greater total production is retarded because consumer buying does not keep pace with production. Consumer buying lags behind for two reasons: first, because industry does not disburse to consumers enough money to buy the goods produced; second, because consumers, under the necessity of saving, cannot spend even as much money as they receive. There is not an even flow of money from producer to consumer, and from consumer back to producer. . . . Under the established system, therefore, we make progress only while we are filling the shelves with goods which must either remain on the shelves as stock in trade or be sold at a loss, and while we are building more industrial equipment than we can use. Inadequacy of consumer income is, therefore, the main reason why we do not long continue to produce the wealth which natural resources, capital facilities, improvements in the arts, and the self-interest of employers and employees would otherwise enable us to produce."

SPEAKING AND WRITING ENGLISH, by Max J. Herzberg and William Lewin. A book of 399 pages, with illustrations, published by Allyn & Bacon, New York City. Price, $1.50.

THERE has been a noticeably large number of books recently published which deal with the use, and one might also say the abuse, of the English language. Whether this is merely a coincidence or a sudden awakening to a need is a matter for speculation. However, it is not to be denied that there is room for vast improvement in the way most English-speaking people use their mother tongue. To a large extent, the present work is of an elementary character, inasmuch as it is designed to help the youth still in school. However, it can be read to advantage by persons of riper years, earnestly intent upon adding to their command of the language and to their accurate use of it.

THE LANGUAGE OF ADVERTISING, by John B. Opdycke. An illustrated work of 494 pages, published by Isaac Pitman & Sons, New York City. Price, $3.50.

THE title of this book would suggest that the language of advertising differs in essentials from the approved ways in which a language is written and spoken. Of course, this is not the case when advertising is carefully and properly written; and the book, itself, is designed to help the copy writer to do his work well and in accordance with the best uses of the language.

As the author informs us, his aim has been to inform, to interpret, and to inspire. The volume is intended primarily for students of advertising, but it is also designed to appeal to anyone having to do with publicity in the widest meaning of the term. Mr. Opdycke tells us that he has aimed to write a readable book while offering a wealth of informative and instructive material. In both of these endeavors he has succeeded admirably; and we heartily recommend the work to those interested in this field of service.

Chemical Engineering Catalog, for 1925. This is the tenth edition of this work published by The Chemical Catalog Company, Inc., New York City. The volume, as its title implies, covers the whole range of manufactured chemical commodities and gives the names of many hundreds of firms whose products are mentioned in the publication. The catalogue is leased by the year at $2 a copy.

Public vs. private ownership of public utilities, by Arthur Williams, is the title of a very interesting paper read by the author during a conference of The League for Industrial Democracy. Reprints of this paper can be obtained gratis upon applying to The New York Edison Company, New York City.

PAVING BREAKER DOES UNUSUAL WORK

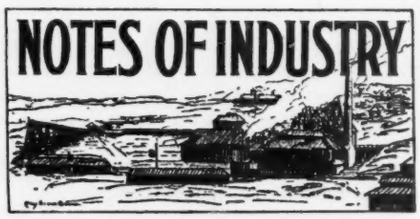
THE demolition of concrete structures of one sort or another is sometimes attended with difficulties, especially when it is impossible to resort to the use of explosives. In remodeling a power plant at Cos Cob, Conn., it was necessary to remove an engine foundation consisting of a solid mass of concrete. This foundation had the usual flywheel well or pit —about 15 feet wide, 20 feet long, and 6 feet deep, and was close to a turbine and generators that had to be kept running. Obviously, blasting was out of the question.

At first, an attempt was made to break up the concrete in the usual manner—that is, with air-driven paving breakers. But this method proved to be too slow. Furthermore, an objectionable amount of dust was raised that had to be held in check by playing water from a hose on the moil points and by wetting the broken concrete before shoveling it into buckets for removal.

It was then decided to try the plug-and-feather system employed in stone yards for getting out blocks of stone. To that end, a series of vertical holes, 1⅜ inches in diameter and 2 feet deep, were drilled with a wet "Jackhamer." These holes were placed from 8 to 12 inches apart and about 3 feet back from the edge of the flywheel pit. Next, the ends of the moil-point steels, that had been used in the paving breaker, were flattened out into taper wedges; and then feathers were made to fit the drill holes—the feathers having a taper that would permit the wedges to enter freely and to tighten up within the last 6 or 8 inches of their travel.

A group of 6 drill holes was handled at one time. This was on a smaller scale than such work is usually done in stone yards, but it served the purpose. With the feathers in place and the wedges greased and started, the next thing was to drive the wedges home. Though not designed for this service, a paving breaker was used—the operator starting at the first wedge and going successively down the line until all six were driven tight and a block of concrete was freed from the mass.

As breakage was not always clean down to the very bottom of the drill holes, that is, as there were sometimes left small toes such as may be seen at a quarry after a number of vertical holes have been shot, it was necessary to do a measure of squaring up after breakage. But this was a small matter: the main thing was that it was possible by the plug-and-feather system to remove the concrete in large pieces and not in small chunks, as was previously the case. Some of the blocks taken out measured 6 feet long, 3 feet wide, and about 2 feet thick. These were handled easily by an available overhead crane and chain. Besides, the amount of dust raised was so negligible that it no longer entered into consideration.

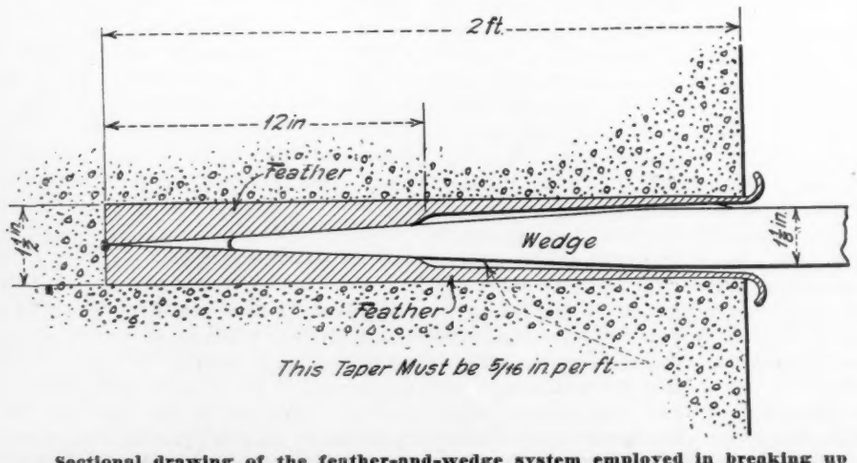


Experience has brought to light that nickel plating, as ordinarily applied, is not a satisfactory protection for iron and steel parts. As the complaint had become fairly general, especially among automobile owners, the United States Bureau of Standards undertook to investigate the matter. Nickel plating is almost invariably porous; but it was found that its protective value would be materially increased by making the plating considerably thicker. It is therefore suggested that one thousandth of an inch should be the minimum thickness applied.

The Government of Chile has promulgated a decree creating a highway congress of a permanent character. The purpose of this organization is to better the roads of Chile and to keep in touch with modern improvements.

Through Shanghai, the gateway of the great Yangtze River Valley and of central China, flows 43 per cent. of the commerce of China.

Australia is today the leading overseas market for United States automobiles.



Sectional drawing of the feather-and-wedge system employed in breaking up the concrete foundation.

New York City, with a population of 6,000,000, uses annually about 5,000,000,000 kilowatt-hours of electricity. Just how big this consumption is can, perhaps, be understood better when it is realized that the combined production, in 1924, of all the generating plants in Greece, Denmark, Latvia, Jugo-Slavia, Poland, Hungary, Norway, Rumania, Turkey, Switzerland, Sweden, and The Netherlands was a little less than 5,000,000,000 kilowatt-hours. These 12 countries have an aggregate population of 109,000,000, or approximately that of the United States.

Through the recent formal opening to the public of the northernmost commercial radio station in Canada, the Arctic circle is now in daily touch with civilization. The station, under the Departments of Interior and National Defense, is located at Aklavik which lies 1,300 miles north of Edmonton.

The policy of reclaiming arid and semi-arid lands in the United States came into being with the passage of the reclamation act in 1902. Since that time the Federal Government has spent $200,000,000 on works to irrigate more than 2,000,000 acres of land that support nearly 500,000 people.

There is a limit to the size of hailstones, and the Weather Bureau of the Department of Agriculture has been searching historical data for the purpose of arriving at some definite figures. There are records of hailstones which weighed more than a pound, but not, apparently, in the United States. On April 17, 1874, hailstones fell in Natal that weighed 1½ pounds and that, on their way to the ground, perforated corrugated-iron roofs. Hailstones 14 inches in circumference fell in New South Wales in February, 1847. At Cazoria, Spain, on June 15, 1829, houses were crushed under blocks of ice which were reputed to have weighed 4½ pounds.

The United States Government is one of the world's greatest proprietors of coal and oil lands.

The total fish catch of the world, according to authoritative statements, is valued at about $1,000,000,000, which is the cost to the consumer. In this industry, Japan ranks first, with a catch worth $90,000,000; then comes the United States with one valued at $85,000,000; while that of Great Britain represents a market return of $75,000,000.

The colonial government of the Belgian Congo is soon to begin the construction of new railroads to provide better outlets for the raw products of the Congo.

In the past decade, investments of American capital abroad have increased from $2,000,000,000 to more than $9,000,000,000.

A new town, to be known as Port Fuad, is to be built opposite Port Said and on the eastern side of the Suez Canal.

Break Ice from City Streets MECHANICALLY at One-Sixth the Cost and Time of Hand Methods

Last winter a twelve-day blizzard tied up traffic in the city of New York. The removal of the snow and ice from the principal thoroughfares and usual conjested downtown streets cost the city about $2,000,000. The loss to business was estimated at $60,000,000.

One storm in Chicago, according to estimates, cost the merchants $20,000,000 in sales. In New York it cost from $80,000 to $100,000 per inch to get rid of the snowfall above the four-inch depth and to keep the streets and sidewalks passable for traffic.

Until very recently, a virtual army of men with picks and shovels was required to remove the ice formed by the partial melting and freezing again of this snow. Now, in the cities especially, this ice is being broken up by machinery—by Ingersoll-Rand Compressed-Air-Operated Ice Picks.

One man using the Ingersoll-Rand Ice Picks can accomplish as much as six men using hand picks. The thicker the ice, the greater will be the saving effected by the Ingersoll-Rand methods.

An "I-R" Portable and Air-Operated Ice Picks can be shipped to you from a nearby Ingersoll-Rand branch warehouse on the same day that your order is received.

We will be glad to send along one of our expert operators to start the machine and instruct your men how to operate it.

Write to the nearest branch office listed below for complete information.

INGERSOLL-RAND COMPANY—11 BROADWAY, NEW YORK CITY.

Offices in principal cities the world over.

CANADIAN INGERSOLL-RAND CO. LIMITED,
260 ST. JAMES STREET. MONTREAL, QUEBEC.

INGERSOLL-RAND CO. LIMITED,
165 QUEEN VICTORIA STREET. LONDON, E.C.4.

53-PC

Ingersoll-Rand

Wings for Machinery

The flying speeds of modern machinery have largely been made possible through the production of such lubricants as high-grade Gargoyle Lubricating Oils.

Based upon 59 years of experience, the Vacuum Oil Company has produced the correct grades of oils for every type of turbine, internal combustion engine, steam cylinder engine, and every other known form of machinery.

Ask a representative of the Vacuum Oil Company to recommend to you the correct grades of these reliable lubricants for all your machinery.

GARGOYLE

Lubricating Oils

A grade for each type of service

VACUUM OIL COMPANY